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SCOTT'S FARM ENGINEERING TEXT-BOOKS

FARM ROADS, FENCES, AND GATES

A

PRACTICAL TREATISE

ON

THE ROADS, TRAMWAYS, AND WATERWAYS OF THE FARM; THE PRINCIPLES OF ENCLOSURES; AND THE DIFFERENT KINDS OF FENCES, GATES, AND STILES

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PREFACE.

ALTHOUGH roads and fences do not contribute directly to the revenue of the farm, and add very materially to the expenses, they are works of indispensable utility.

A judiciously planned system of farm roads enhances the value of the fields adjoining them, and without a sufficiency of fences the livestock of the farm could not be controlled nor the growing crops protected.

One of the most important items in large agricultural undertakings is the cost and facility of transport. It is every day becoming more essential to accomplish the removal of heavy crops and the application of heavy manures in the most expeditious way and at the cheapest possible rate. This can only be done where there is a well-devised system of well-kept roads, tramways, or waterways on the farm.

The subject of enclosures is an interesting one from many points of view, including as it does not merely the modern use of fences, but the ancient mode of marking the divisions of family estates (still practised by many of the modern nations of Europe) by boundary-stones or other landmarks, and the influence of enclosures and fences on shelter and climate.

Few non-agricultural readers would surmise that for every acre of enclosed land in this country there is over £1 invested in fences, and that the annual maintenance of these fences costs something like 3s. per acre.

Taking these figures in the aggregate, as applied to the 45,000,000 acres of enclosed land in the United Kingdom, their magnitude becomes at once apparent, for it shows the total capital sunk in fences to be nearly £50,000,000, and the annual maintenance and repair of these fences to cost at least £6,750,000.

There is no denying, however, that many existing fences might be dispensed with to the great advantage of agriculture, apart altogether from the expense of maintaining them.

The extended introduction of a cheap and durable system of wire fencing renders possible still further economy in the matter of fences. This is more especially true of barb wire fences, in which fewer lines of wire make an equally efficient fence, and that with only one-half to one-fourth the number of posts which it is considered necessary to use in plain wire fencing or in post-and-rail fences.

All the different kinds of fences now in use are noticed at such length and in such detail as their importance demands and the limits of the book admit.

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FARM ROADS, FENCES, AND GATES.

CHAPTER I.

FARM ROADS.

Good roads are rarely met with on the farm. True, there are exceptional instances where the facilities afforded by a carefully designed and well-constructed system of roads have been attained, but such cases mostly occur under the immediate occupancy of an energetic and wealthy resident proprietor, or on the home farms retained by the proprietors of the larger estates. They do not, therefore, present any appreciable limit to our first statement, and are only to be regarded as examples of, and inciting to, a better than the prevailing state of things. On the majority of farms in this country, indeed, there is not a single furlong of *made road*—*i.e.* of road solidly constructed and kept in repair—except the comparatively short lengths leading from the public highways to the homesteads.

In an age of universal progress and advancement, the roads of the farm have received no general attention, and, indeed, are in little better condition than they were a century ago. It is not sufficiently recognised that the purpose of those internal communications is to reduce the cost of horse labour, and that a farm

with a properly devised system of good roads is worth more to the occupier than it would be without such facilities.

Especially in clay-land districts, where good roads are most wanted, the majority of farms suffer from the narrowness and bad construction of the roads. There are many by-roads and lanes, over which there is much farm traffic at certain seasons of the year, that seem to be cared for by nobody. The result is that the harvest load may be seen fighting its way up the narrow lanes, while every hedge or tree takes a due tithe of the crop; or a good team is found pulling each other to pieces, with the wheels of the market-waggon or dung-cart nearly buried in the ruts of the road from the homestead.

Some lands there are, undoubtedly, so situated and of such a character that it would be superfluous to cut them up by internal roads; such, for example, where dry and flat grounds lie adjacent to or are bounded by public or occupation roads. It may then occur that the easy access to a good road and the contour of the field, together with the character and drainage condition of the soil, render the construction of roads inside the fences quite unnecessary. But that is not a very common occurrence, for even where a farm is well intersected by public or occupation roads, and the contour of the land flat, there will still be many fields which lie interior to those which abut upon the roads in question; and, wherever in order to reach one field another has to be crossed, it will always be advantageous to have a road. If there is much cart or waggon passage across a field, it will actually become an economy to devote a portion of the land to the purposes of a permanent road. Of course, where the

ground is steep or otherwise naturally unsuited to farm traffic, it often becomes a first necessity to open it up by a substantial road, even though a good road runs across the outside boundary.

But we are not to be held as advocating the indiscriminate construction of roads. Far from it. We think that the fewer they require to be the better, for the first construction is very costly, and the labour and expense of maintenance is considerable, while they occupy a large amount of valuable land. Yet it is not too much to say that at every place where a necessity exists for a road, at such a place the needed facility should be provided. There should, indeed, be a well-defined and complete system of roads upon every farm, providing easy and ready access to every field without having to pass through another field. Every field should communicate with the road by its own gate, and have no dependence on any other passage. This convenience has not been sufficiently attended to; but it is equally necessary with the provision that each room of a dwelling-house should have an entry from the hall or passage without intruding through another room. This very necessary arrangement requires that a road passes between four fields in width, with two fields on each side of it, which open into the road from opposite sides, and it is convenient that the gateways terminate the headlands of the field, and have an entry at both ends —on the upper and lower headlands. At the same time, a gate must open from one field into another for convenience' sake, but not for a common thoroughfare; and it is then best placed at the end of the field, and in the line of the headland.

It is reasonable to suppose that with the introduction of heavy machinery—such as agricultural locomotives,

&c.—more general attention must be paid to farm roads, for a firm path is essential to the ready transport of these engines. But apart altogether from the requirements due to the introduction of heavy modern implements and machinery, it cannot be said that the permanent improvements on any estate or farm are complete without a definite system of good roads.

These roads, as being of the nature of permanent improvements, should be constructed at the expense of tho proprietors, and maintained by the tenants or occupiers of the land.

The cost of such a system will materially depend upon the skill with which it is designed and laid out. It is surprising to any one who has never seen or attempted such a work with what economy it is possiblo to lay even a hilly farm under road control. And who can estimate the value of such a boon; the pleasure, the facility, and the profit derived; or the annoyance, the delay, the ruts, and the waste avoided thereby?

The important question, "What is the value of a farm with good and sufficient internal communication, and what the value of the same farm without any?" is answered as follows by Mr. J. Bailey Denton, in a paper on tho subject of "Farm Roads," read by him before the London Farmers' Club some years ago. "Let us suppose," says Mr. Denton, "a farm of 500 acres, of a heavy clay soil, with the homestead in the centre, and good public roads on two sides of it. Five hundred acres will cover a square of seven furlongs on each side; and it would probably require two miles of road to give moderate accommodation to such a farm. This, at an average price of £5 a chain, will cost £800, and if we take the interest at £5 2*s.* 10*d.*

per cent. (the rate of instalment for repayment of principal and interest charged by the General Land Drainage and Improvement Company), the annual charge will be £41 2*s.* 6*d.* Is such a farm permanently improved by the acquisition of a road to the annual amount of £41 2*s.* 6*d.*, or 1*s.* 8*d.* per acre? When we consider that this annual sum of £41 2*s.* 6d. will barely cover the keep of one horse and a half, without regard to the wear and tear of the horse itself, and of carts, harness, and implements, I think we shall all answer in the affirmative. In such a farm of 500 acres, 400 acres being arable and 100 acres pasture and meadow, the produce of manure will be, under ordinary good management, from 1,400 to 1,500 tons of manure in the whole. This will suffice to give a dressing of 12½ tons to 116 acres, and the number of miles travelled in doing that will be 966, out and back, if we take the average road-lead to be one-third of a mile, or 27 chains. Now, if we remember that in heavy land we may not only pull our horses to pieces, but injuriously affect the land itself, if we do not take advantage of every hour of dry weather, but prolong the operation during wet weather, it is hardly possible to overrate the advantage of a hard road which will allow of a horse to travel at least 20 miles daily with the same ease that he will travel 12 or 13 miles doing the same work through clay mud. The difference of 28 days, which these figures show, in the time it will require to get manure on to the land, is one consideration which will go far to meet interest on the outlay of working the road, leaving out of consideration the injury done to tillage as well as damage to horses by carting over clay soils on wet days. If, therefore, we add all these advantages together—the gain in time, in power, in the wear and tear of carts and implements,

and in the personal comfort of the occupier—there can be no doubt that 1*s.* 8*d.* per acre represents at least the value of the improvement in this assumed case; and we shall not be overstepping truth and practice in the resolution we may adopt if we assert, in general but decided terms, that the existence or non-existence of internal roads on a farm is an essential element in determining the rent that should be paid for it; and that the provision of farm roads, being a permanent improvement, and in the case of clay soils a very costly one, the outlay is properly a landlord's and not a tenant's duty."

CHAPTER II.

PRINCIPLES OF ROAD-MAKING.

"A ROAD, to be theoretically perfect," says Dr. Lardner, in his evidence before the Committee of the House of Commons, 1836, "should be, first, perfectly straight; second, perfectly level; third, perfectly smooth; and fourth, perfectly hard. If it possessed all these qualities in absolute perfection, the consequence would be that it would require no tractive power at all—an impulse given to a load at one end would carry it to the other by its inertia alone. This is the ideal limit to which it is the business of the road-maker to approximate as nearly as he can, all practical circumstances being considered. But, as it is obviously impossible to make roads in the country which would be perfect, there arises in most cases the extremely difficult inquiry as to the best possible compromise which can be made between all the inevitable imperfections the existence of which we are forced to admit."

Resistance on Roads.—The resistance or draught on roads is an important matter, a proper knowledge of which is of advantage in considerations regarding the gradients proper to be admitted in a line of road. It has been found by experiment that the resistance by wheel-carriages on roads is proportional to the load, and inversely proportional to the radius of the wheels.

The average proportion of the resistance to the load on a level part of a good broken stone road has been variously stated at from 44 lbs. to 75 lbs. per ton. Telford estimated it at $\frac{1}{30}$th of the gross load, or $74\frac{2}{3}$ lbs. per ton. That is to say:—

As the resistance : the load :: 1 : 30;

or,

$$\frac{\text{Resistance}}{\text{Load}} = \frac{1}{30} = \frac{74\frac{2}{3}}{2240} \text{ lbs.}$$

Sir John Macneil estimated the force required to move a ton weight on roads of different construction as follows:—

On a well-laid pavement	33 lbs.
On a broken stone surface, having a bottom of rough pavement or concrete	46 ,,
On a broken stone surface laid on earth . .	65 ,,
On a gravel road	147 ,,

On an incline the resistance varies according to the sine of the angle of inclination, and we have this general rule for finding the amount of resistance to be overcome: To the known ratio of resistance of load on a level, add (if ascending), or subtract (if descending), the ratio of the rise to the horizontal length of the slope, and multiply by the gross load.

The result gives the resistance very nearly. Thus, for example, if we assume the resistance on a level to be $\frac{1}{30}$th of the load, the force required to draw a waggon of 3 tons weight along a level part of a macadamized road is ($\frac{1}{30}$th × load) = ($\frac{1}{30}$ × 6,720 lbs.) = 224 lbs.; but the force required to draw the same load on an incline of 1 in 60 is $(\frac{1}{30} \pm \frac{1}{60}) \times 6{,}720$, which gives 336 lbs. as the force to be exerted in ascending, and 112 lbs. in descending, the slope; while in a gradient of 1 in 30 the force required is $(\frac{1}{30} + \frac{1}{30}) \times 6{,}720 =$

448 lbs. in ascending, and $(\frac{1}{30} + \frac{1}{30}) \times 6,720 = 0$ in descending.

From these and such-like calculations we thus find that the comparative values of resistance to the same load on different slopes stand thus in ratio :—

Inclination.	Resistance.	
	Ascending.	Descending.
Level	1	1
1 in 60	$1\frac{1}{3}$	$\frac{2}{3}$
1 in 30	2	0
1 in 15	3	— 1
1 in 10	4	— 2

Consequently, if we estimate the tractive force which a horse is capable of exerting continuously at a steady walk at 112 lbs., each horse will be able to draw along a level a gross load of $(112 \times 30) = 3,360$ lbs. $= 1\frac{1}{2}$ tons; while on an ascent of 1 in 60 a load of $(112 \times 30 \div 1\frac{1}{3}) = 2,240$ lbs., or 1 ton would be sufficient; and on an ascent of 1 in 30 the load, to be drawn with advantage, must not exceed $(112 \times 30 \div 2 =)$ 1,680 lbs. = 15 cwt.

From these results we observe that since the resistance is doubled by an ascent of 1 in 30, it will be exactly neutralised in descending a slope of the same inclination. Hence, if the gradient at any part is steeper than 1 in 30, there is a waste of mechanical energy in descending, because a retarding force must then be exerted, by means of brakes or otherwise, in order to prevent undue acceleration of speed. This is shown by a minus sign prefixed to the two last figures in the third column of the foregoing table.

These results establish the advantages arising from easy gradients, but, of course, the question of expense

in excavating and embanking limits, in most cases, the flatness of the gradients, and farm roads especially are as much as possible constructed on the natural surface of the ground.

To put the case more tangibly, "We find," says Mr. Denton, "many farms abound in steep hilly slopes with inclinations of 1 in 30, or even steeper; and it has been practically demonstrated that the expense of power in £ *s. d.* required to draw a load of 1 ton along a common road of various gradients is 6*d.* where horizontal, to 8*d.* where there is a rising gradient of 1 in 30. If we adopt this comparison, we see that (all other points being equal with respect to formation and condition) the comparative saving of a level road over a rising gradient of 1 in 30 is 2*d.* per ton in the ordinary cost and application of horse labour on a farm."

At Bedford, in 1874, Messrs. Easton and Anderson tested the resistance to traction of agricultural carts and waggons by means of their new horse dynamometer.

The trials were conducted (1) along a hard road having a rise of 1 in 430; and (2) along an arable field of oat stubble, rather drier and harder than common, with a rise of 1 in 1000.

The fore wheels of the waggons averaged 3 ft. 3 in., and the hind wheels 4 ft. 9 in. in diameter, the width of the tires being 2½ and 4 inches. Empty waggons averaged about a ton in weight; and the loads were from 2 to 4 tons in a waggon.

The cart wheels were 4½ feet high, with tires 3½ and 4 inches wide. The weight of the empty carts averaged 10 cwt.; and the loads were 1 ton in a cart.

On the foregoing data, and with the speeds averaging 2½ miles per hour, the following results were deduced from the experiments:—

Description of Vehicle.	Draft on Road.		Draft on Field.	
	Total.	Reduced to a Level. Per Ton gross.	Total.	Reduced to a Level. Per Ton gross.
	lbs.	lbs.	lbs.	lbs.
Pair-horse waggon without springs	159	43·5	700	210
Four-horse ditto	251	44·5	997	194
Pair-horse waggon with springs .	133	34·7	710	210
One-horse cart without springs .	49·4	28	212	140

Line of Road.—The principal points to be attended to in selecting the line of a road are, that in crossing valleys or hollows a narrow part of the valley should be chosen, and the deepest part should be crossed at right-angles. The summits of ridges also should be crossed at right-angles; and when roads pass through fields they should, as far as practicable, be formed alongside of the fences, to avoid the subdivision of the fields and consequent loss and inconvenience in working the land.

The most level line between certain points, although it may not be the shortest, is generally preferred. Straight lines are always best, but sometimes debarred by the surface of the ground and other obstacles. To follow the mathematical axiom, that a straight line is the shortest that can be drawn between two points, will not always succeed in making the most commodious roads. A straight and level line is possible only in a country which is perfectly flat, and where no obstacles lie in the way—joint circumstances that rarely happen.

"Cutting through low hills to obtain a level is recommended by some who," Paterson observes, "will argue that where the hill of descent is not very long, it is better, in that case, to cut through it in a straight line and embank over the hollow ground on each side than to wind along the foot of it. This, however, should

only be done where the cutting is very little indeed, and an embankment absolutely necessary. Few people, except those who are well acquainted with the subject, are aware of the great expense of cutting and embanking, and the more any one becomes acquainted with road-making, the more, it may be presumed, will he endeavour to avoid those levels on the straight line that are obtained only by cutting and embanking, and will either follow the level on the curved line round the hill, or, where this is impracticable, will ascend the hill, and go over it by various windings, avoiding always abrupt or sudden turnings."

Edgworth was of opinion that a strict adherence to a straight line is of much less consequence than is usually supposed, and that it will be frequently advantageous to deviate from the direct line to avoid inequalities of ground. It is obvious, as he pointed out, that, where the arc described by a road going over a hill is greater than that described by going round it, the circuit is preferable; but it is not so generally known that within certain limits it will be less laborious to go round the hill, though the circuit should be much greater than than that which would be made in crossing the hill.

There are many roads crossing hills which might be made nearly level by deviating a little to the right or to the left. A road is required, say, to connect two points three miles apart, but separated by a hill 100 feet high, and in order to avoid this ascent it is necessary to deviate the line half a mile on either side; yet the road thus curved is only 148 yards, or $\frac{1}{12}$th of a mile, longer than if it had been made to pass over the hill. Whether it is expedient to make the road so much longer to avoid that ascent may soon be ascertained. Telford, as we have seen, estimated the resistance to the load on a level

part of a good broken stone road at $\frac{1}{30}$th of the load. A rise of 1 foot in 30 will therefore increase the draught equal to the resistance. In other words, the road may be increased 30 feet in length in order to avoid a rise of 1 foot; or it may be increased 1,000 yards in length in order to avoid an ascent of 100 feet. Where there is much cartage to be done, the greater ease of travelling and the heavier loads drawn on the level would soon do more than compensate for any additional outlay in constructing the longer road.

Bottoming.—In regard to the formation of the road-bed, there are two systems—that of Telford and that of Macadam. The system of Telford is principally a revival of that employed by the old Romans, and consists of laying heavy stones at the bottom of the bed and covering them with a coating of broken stones. Several excellent roads were constructed by him on this principle, the permanence of which are evidence of his engineering wisdom, *e.g.* the Glasgow and Carlisle road, and the road between Holyhead and Shrewsbury. Macadam preferred a yielding to a rigid foundation, and substituted small angular broken stones, laying them directly upon the earth, even upon boggy ground. The angular shape of the stones caused them to bind together somewhat; but the superiority of roads having large stones or concrete (which is preferable, and much employed in the construction of town roads since the manufacture of hydraulic cement became so general) for a foundation is now generally conceded.

"Most failures in road-making have arisen from not having a foundation of depth and dryness sufficient to prevent the road being sunk into the under-stratum of original deposit, and to uphold the upper pressure from sinking the broken materials into the foundation and

getting mixed together. In this way both the foundation and the road are lost from being too scanty; the one sinks into the other, and no part is sustained to form the desired object. The foundation must be calculated to sink so far as to find a resting-place on grounds that are not very bearing of pressure, and which remain soft after being drained; the thickness must be sufficient to prevent any extensive mixture with the underlying soil. With the upper bed of broken stones no sinking must take place; the strength and dryness of the foundation must prevent any mixture, except the sinking that will happen from the pressure of the rolling weight. This will not be large when the directions are observed of a dry bottom and thick foundation, and the proper broken materials all duly provided and economically applied."

Covering the base of an unsound road with faggots, branches, furze, or heath is recommended by Edgworth but condemned by Macadam, whose plan was to drain effectually and put no intervening material between the broken stone and the earth.

"Roads," says Macadam, "can never be rendered perfectly secure until the following principles be fully understood, admitted, and acted upon, namely, that it is the native soil which really supports the weight of traffic; that while it is preserved in a dry state it will carry any weight without sinking, and that it does, in fact, carry the road and carriages also; that this native soil must previously be made quite dry, and a covering impervious to rain must be placed over it to preserve it in that dry state; that the thickness of a road should only be regulated by the quantity of material necessary to form such impervious covering, and never by any reference to its *own* power of carrying weight. . . . .

Every road is to be made of broken stone, without mixture of earth, clay, chalk, or any other matter that will imbibe water or be affected by frost; nothing is to be laid on the clean stone on pretence of binding. Broken stone will combine by its acute angles into a smooth solid surface that cannot be affected by vicissitudes of weather or displaced by the action of wheels, which will pass over it without a jolt, and consequently without injury."

Macadam was anticipated in his system by Edgworth, who "advocated the breaking of the stones to a small size and their equal distribution over the surface. The latter also recommended that the interstices should be filled up with small gravel or sharp sand—a practice which, though it was condemned by Macadam, is now adopted by the best surveyors." *

Road Surface.—"The smoothness of a road depends on the size of the stones used in forming it, and on their compression either by original rolling or the continued pressure of wheels. The continued smoothness of a road during its wear depends on small stones being used in every part of the stratum; for if the lower part of it, as is often the case in the old style of forming roads, consists of larger stones," the jarring of heavy loads and the action of the weather cause the small surface stones or gravel to sink down between the larger stones, until many

Fig. 1.

of the latter work out on the surface, and the road becomes almost impassable after a few years. Fig. 1 illustrates

* "Roads and Streets." Crosby Lockwood & Son.

the condition of such a road when newly constructed, and Fig. 2 the bad repair into which it has sunk when cut through by heavy traffic.

Fig. 2.

Nothing is so destructive to vehicles, horses, and harness as a road full of ruts and covered with loose stones, or with fixed stones projecting two or three inches above the surface. "If the road is smóoth and even, the waggon with its load moves along without jar or detriment; but as soon as a projecting stone is struck the whole load is suddenly arrested, or else it must be lifted to mount the obstruction. This is distinctly represented by Fig. 3, where the curved dotted line shows the upward course which the axle, with its incumbent load, must take in order to pass the stone in the track.

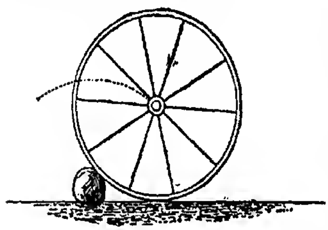


Fig. 3.

A single loose stone, which might be thrown out of the way in two or three seconds, is struck by passing waggons fifty or a hundred times in a day, and many thousand times in a year. The damage which it may do to all the vehicles driven over it may amount, in the aggregate, to many pounds, while it may be removed for less than a farthing."—*Albany Cultivator.*

Transverse Form.—Opinions differ a good deal as to the best tranverse form of a road. Some think it should be

flat, others that it should be higher at the middle than at the sides. There can be no doubt that it should have a certain amount of convexity, but evidently the road will be most suitable for traffic if the convexity is not more than sufficient to make the water that falls on it run off from the middle towards the sides. The convexity may always be reduced to a minimum by giving a slight longitudinal inclination to the road, and a dead level *should always be avoided on considerations of drainage. It has also been debated whether the convexity should* be given to the foundation or to the surface material only. Telford's system gives the convexity to the "bottoming," by which method a uniform depth of "metalling" is obtained over the whole breadth of the road. If the convexity is given only to the surface material, it must be laid on thicker at the middle than at the sides of the road, and as the traffic usually preponderates in the centre, the more so if the cross-section has a considerable convexity, the action of horses and machines must tend to throw the metal from the centre to the sides, and thus to reduce the road to a level, or to form grooves and ruts. On the best roads the decline from the crown or middle of the road to the side edges is never more than 1 in 50 to 1 in 72, but in narrow country roads it is considerably greater.

Rules of the Road.—In Great Britain there are two well-settled rules, namely, (1) when two vehicles meet, each must bear to the left; (2) when one vehicle overtakes another, the former draws to the left of the way and the other passes by on the off side. In the United States of America, two vehicles meeting bear to the right instead of to the left, but with this modification the rules of the road are the same there as in England. These rules do not apply to equestrians or pedestrians.

CHAPTER III.

CONSTRUCTION OF ROADS.

Foundation.—It is a common practice, in forming a new road, to dig a trench below the surface of the ground adjoining, and in this trench to lay the road-bed or material. "Were the materials of which the road is composed properly selected, prepared, and laid," Macadam remarks, "some of the inconveniences of this system might be avoided; but in the careless way in which the work is generally performed the road is as open as a sieve to receive water, which, penetrating through the whole mass, is received and retained in the trench, whence the road is liable to give way in all changes of weather. A road formed on such principles has never effectually answered the purpose which the road-maker should constantly have in view, namely, to make a secure level flooring, over which vehicles may pass with safety and equal expedition at all seasons of the year. . . . As no artificial foundation can be made so good and so useful as the natural soil in a dry state, it is only necessary to procure and preserve this dry state of so much ground as is intended to be occupied by a road.

"The first operation in making a road should be the reverse of digging a trench. The road should not be sunk below, but rather raised above, the ordinary level of the adjacent ground. Care should at any rate be

taken that there should be a sufficient fall to take off the water, either by making drains to lower ground, or, if that be not practicable, from the nature of the country, then the soil upon which the road is proposed to be laid must be raised by addition, so as to be above the level of the water."

Width.—It is recommended that roads be made wide. The first cost of a wide road is, of course, greater than that of a narrow road; but it is an error to suppose that the cost of repairing a road depends entirely upon the extent of its surface, and increases with its width. On a narrow road the traffic is confined very much to one track, and the road is consequently worn more severely than when the traffio is spread over a larger surface. Narrow roads are almost always in bad condition, from the circumstance of every cart or waggon being obliged to go in the same ruts.

The proper width of roads must, however, depend largely on local circumstances. Rules cannot be given to suit every situation nor every farm. The breadth ought to be regulated by the nature and amount of traffic upon the road. Every road should, however, be sufficiently broad to admit of two vehicles passing each other. A width of 13 to 18 feet, prepared for vehicles, will usually suffice for the main road or roads of the farm. For field or cross-way roads the width may be much less, the metalled portion not exceeding 10 feet, while the wings may be left as earth roads. It is a great improvement on all main roads about the farm to have a side-path for travellers on foot, and new roads leading from the farmery to the public highway are now generally so constructed.

Formation.—When a road has to be formed on the natural surface of the ground, the operation consists

simply, when the ground is level across, in digging a drain or ditch at each side of the intended road, the earth from which is thrown upon the track so as to raise it a little above the adjoining ground, and slight inequalities which occur in its course are then levelled. If the ground has a sidelong slope, a drain at the upper side of the road only requires to be cut. Macadam, as we have seen, considered this to be all the preparation needed, even on swampy ground, before laying the broken stone covering on a road. Telford believed it necessary to have a foundation of rough pavement (Fig. 4.) below the upper covering, and this he formed of durable stones measuring from 4 to 7 inches, which were set by

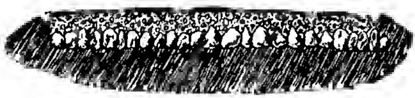


Fig. 4.

hand with the largest sides down, and packed with smaller pieces, so as to form a compact layer of about 7 inches deep at the centre and 4 inches deep at the sides of the road. Above the foundation thus prepared Telford spread a uniform coating of broken stones about 6 inches in depth. Macadam thought 10 inches of metal the greatest thickness required for any road made upon his system, and he often used from 5 to 9 inches as sufficient. In order to carry off the rainfall, the surface slopes from the centre toward the side drains or gutters. This inclination may be 1 in 30 for rough roads, and 1 in 60 for main roads on the farm. A rise of 3 inches at the centre is common for roads 18 feet wide, being 1 in 72.

Road Material.—The road metal should consist of

tough and hard stone, such as granite, or some of the varieties of greenstone. Next in order are some sorts of limestone and hard sandstone. Limestone is the principal material in Wiltshire, Somersetshire, Gloucestershire, and Ireland; granite and trap in the north of England and Scotland; slate-stone in North Wales; sandstone pebbles in Shropshire and Staffordshire; flint in Essex, Sussex, and part of Kent; and gravel in Middlesex and Surrey.

The hardest metals, however, are not always the most durable. Toughness is even a more desirable quality in the stone than hardness. Some stones, although very hard, are so free and brittle that they will grind down by the wheels rather easily, and in times of rain will be formed into mud; while, on the other hand, there are stones not so hard that are yet so tough that they waste very slowly, and will last longer than the former on any road whatever.

It has been remarked that in various parts of England where limestone is used the roads are best; and this superiority is ascribed not merely to the hardness of the material, but also to its adhesive or cementing property.

"Flints, reduced to a small size, and mixed with chalk, make an excellent road in dry weather; but, chalk being very absorbent of water, they become slippery and soft in moist weather, and are much affected by frost."

Gravel is the worst material for making roads. Being composed chiefly of hard sand, and smooth, little round stones, it does not so easily bind together, and seldom makes a very firm road, though pit gravel, which is mixed with a larger portion of clay than river gravel, be used. On the other hand, stones that

are broken have so many sides that they readily lock into one another; whereas the small round gravel keeps rolling and shifting about by every motion of the wheels. All road metals, therefore, should be of stones so large as to require breaking before they are used.

To insure a firm and compact surface, the stones should be broken into angular pieces about 1½ inches cube, and spread evenly over the road with a shovel and rake in two or three successive layers of 3 or 4 inches deep, each layer being well rolled down or allowed to get partially consolidated by traffic before another is put on.

Macadam's criterion for size was weight; and 6 ounces was the maximum for every part of the stratum. Many of his would-be followers have, however, fallen into the error of supposing that all the stones should approximate to that weight, and recently there has been some danger that this view of the subject would get generalized. This is from not understanding principles.

On being asked by the Road Commissioners to mention the proper dimensions, Macadam stated that none of the stones ought to be larger than would pass through a 2-inch ring, nor exceed 6 ounces in weight. "I hold," he said, "6 ounces to be the maximum size. If you made the road of all 6-ounce stones it would be a rough road; but it is impossible but that the greater part of the stones must be under that size."

"By reference to weight," remarks Stephenson, "the road-maker's operations become more precise; but regard should also be had to the specific gravity of the material, which differs considerably, For example, granite may be taken at 12 cubic feet to the ton, and

whinstone (greenstone, basalt, &c.) is often met with of similar weight. Compact limestone and flint are about 14, and quartz sandstone about 15, feet to the ton."

Paterson and other road-engineers have expressed their disapproval of Macadam's 6-ounce test, and think the 2-inch gauge-ring preferable, as there are many stones under 6 ounces that are yet of a very improper shape and size.

Since the introduction of stone-breaking machinery, with cubing and crushing jaws, the road metal can be prepared of any size or fineness; but, on many roads where the machine is used, and more generally where hand-breaking continues to be practised, the stones used are badly broken and unwarrantably large. This is a defect that can and should be promptly remedied on all the public highways. These stone-breakers are made of all sizes, from 7 by 4 to 25 by 16 mouth, and are capable of breaking from 15 to 130 tons of road metal per day, according to the power of the machine.

Gravel for roads ought to be properly cleansed of every particle of clay or earthy substance, and its different sizes separated and arranged by screening. In this gravel the stones are of different sizes and different shapes; and all those that are round, as well as the larger ones, should be broken into angular pieces before being laid on.

Modern Road-making.—The use of binding material on broken stone roads, which was condemned by Macadam and others, is now considered an absolute necessity by the majority of road-makers. The heavy rollers now employed for compressing and settling new materials render the application of sharp sand or gravel necessary to prevent the crushing of the metal. Telford always applied some such binding material to the new metal;

and his practice in this respect is now followed on all roads where road-rolling is understood and practised. The binding of rolled roads is thus so strong that the upper crust may be raised in cakes several feet square, which could never be done without the sand. The sand is only to be applied when about two-thirds of the road metal has been rolled down. "It is essential that this small stuff should not be applied earlier, or it will get to the lower strata, and not only be wasted but injurious. The object is that it should penetrate for two or three inches only, to bind the surface. Provided the upper interstices are filled, the less sand or small gravel used the better; therefore it is applied little by little after each of the three or four last successive passages of the roller, and then only over the places where there are open joints." * Some of the steam-rollers now employed in consolidating new-made roads weigh 30 tons. Rolling is best done in wet weather; otherwise the roads should be watered during this operation.

On farm roads, as a rule, no binding material is used and no rolling is done. The bottom layer, 12 to 18 inches thick, is made of broken bricks, stones, flints, lumps of chalk, or other hard rubbish; and the finishing layer consists of about 6 inches of small broken stones, flints, or gravel.

When a first-class road is to be made the modern practice is as follows: First the ground is levelled and rolled. Then a bottoming of broken stone or other hard material is laid in 12 inches thick, and rolled down to 9 inches. Over this is spread a layer of well-burnt clay or ballast 5 inches thick, and rolled solid to 3 inches. In some districts this is cheaper than broken stone, and the ballast serves to fill up interstices in the bottoming.

* General Sir J. F. Burgoyne, "On Rolling New-made Roads."

Upon the prepared surface of the ballast are laid the small broken stones which form the surface of the road. These are put on in two successive layers, each 3 inches thick, and rolled to 2 inches. With the last layer of small stones, about half an inch of sharp sand is mixed, and the two rolled in together with plenty of water.

Drainage.—If the drainage of the road is to be effected by means of open side-drains or ditches, these should not be made deeper than is necessary, and, if practicable, the fence, if any, should be placed between the side-ditches and the road. It will then be essential that small openings be formed at least every 15 yards to convey the water from the side-tables or gutters through the fence into the ditches. The side-tables, or water-tables, should be made an inch or two lower than the sides of the road.

Open drains, however, occasion an unnecessary waste of ground, besides not being free from danger to passengers and carriages when the road is narrow and there is no fence between it and the ditches. It will, therefore, in the majority of cases, be advisable to form covered drains along the sides of the road, with gratings at proper intervals to let in the surface water. A large-sized pipe should then be laid at the bottom of the drain surrounded with small stones, and upon these smaller stones or gravel to a level with the surface. If the side-drains are constructed in this way, and run immediately underneath the side-table *a*, Fig. 5, no gratings

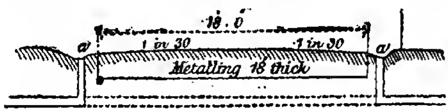


Fig. 5.

will be necessary, as the surface water will then readily find its way into the drains. A cross-drain is also shown by dotted lines in the section of the road, Fig. 5, but this will only be needed where depressions occur in the line of road and the water has to be discharged from the road-drains into some natural water-course. A section of such a cross-drain is shown in Fig. 6.

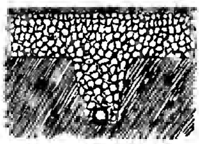


Fig. 6.

Where the ground has a side-long slope, or a road has to be formed on a hill-side, a single drain at the upper side of the road, as in Fig. 7, is all that is necessary, with cross-drains at intervals to discharge the water to the lower side of the road.

A single covered drain down the centre of a roadway is objectionable, because the surface water cannot

Fig. 7.

reach it without penetrating the road-bed, which is incompatible with the maintenance of a hard and smooth surface.

Fences.—Many of the roads about a farm can be left open or unfenced with perfect safety and convenience. At any rate, it is seldom that a road requires to be fenced on both sides, if we except the main road leading from the public highway. Where road-side fences are necessary they should be of an open kind, such as a wire-fence or a post-and-rail fence. If close fences, such as dykes or hedges, are in existence, they should not be

higher than 5 or 6 feet, as they shade the roadway and interfere with its ventilation, and by keeping it always moist make the draught excessive. Trees are worse than hedges when they overhang a road, because they not only deprive the road of the benefit of air and sun, but they further injure it by the dripping of rain from their leaves, as a consequence of which the road is kept in a wet state long after it would otherwise have been dry.

Cost.—The expense of road-making will be found to vary, even in the same district, as, in addition to the cost of labour and the nature of the ground, very much depends on the facility for obtaining the necessary materials. In one case we have converted an old lane, which was previously a perfect quagmire, into a good hard road at a total cost of 3*s*. 8*d*. per lineal yard. The stone in this instance had to be dug out of the ground, and was laid on 12 inches thick and 13 feet wide. The above price includes draining the road, throwing up the surface, digging, carting, and breaking the stone, and laying it on. Mr. Dawson states that he has made many gravel roads, 12 to 18 inches thick, at a cost of from 2*s*. 6*d*. to 3*s*. 6*d*. per square yard. Country roads formed of broken stone commonly cost from 1*s*. 2*d*. to 1*s*. 6*d*. per square yard.

Mr. Denton states the cost of farm roads made in various parts of England at from £3 to £6 10*s*. per chain, and gives the following examples: (1.) A road made in the New Red Sandstone district, of which the bottom stratum, 6 inches thick, was formed of a rough paving of local stone, covered with 4 inches of broken limestone, cost from £4 12*s*. 6*d*. to £6 17*s*. 6*d*. per chain. (2.) A road in a fen district, in which perforated bricks, laid flat on a convex base, and covered with burnt

ballast, formed the bottom stratum, with a surface-covering of screened gravel, was estimated to cost £5 17*s*. 6*d*. per chain. (3.) A road in the Lias and Oxford Clay district, with the bottom stratum of burnt ballast, and the top of screened gravel, cost from £4 10*s*. to £5 10*s*. per chain. (4.) A road in the London Clay district, the bottom stratum of chalk, and the surface-covering of screened gravel, cost from £3 10*s*. 6*d*. to £4 15*s*. per chain. Reducing the chain to yards, we find that Mr. Denton's roads cost from 2*s*. 7½*d*. to 5*s*. 11½*d*. per lineal yard. Their width is not stated, but it may be assumed that they are about the average width of farm roads.

Repairs.—The repair of a road consists in keeping it smooth and clean, and should commence immediately after it is made. Hollows must be filled up, to prevent water standing on the road and the formation of ruts; and loose stones and mud must be assiduously taken off. After a time, a thorough repair or surface renewal by a coating of broken stone over the whole of the road may be required. The stones gathered off the fields will afford a greater or less supply of materials, and must be laid in convenient places and prepared by breaking ready to be put on when needed.

In repairing a broken stone road, the surface should be slightly loosened with a pick, and a layer of new metal spread evenly over it, and well consolidated by heavy rolling.

For the repair of an old road, Macadam directs that no addition of material is to be made, unless in any part it be found that there is not a quantity of clean stone equal to 10 inches in thickness. The stone already on the road is to be loosened up and broken, so that no piece shall exceed 6 ounces in weight. The stones, when

loosened in the road, are to be gathered off by means of a strong heavy rake, with teeth $2\frac{1}{2}$ inches in length, to the side of the road, and there broken, and on no account are stones to be broken on the road. When the great stones have been removed, and none left in the road exceeding 6 ounces, the road is to be put in shape, and a rake employed to smooth the surface, which will at the same time bring to the surface the remaining stones, and will allow the dirt to go down. When the road is so prepared, the stone that has been broken at the side of the road is then to be carefully spread on it; not in shovelfuls, but scattered over the surface, one shovelful following another and spreading over a considerable space. The tools to be used are strong picks, but short from the handle to the point, for lifting the road; small hammers of about one pound weight in the head, the face the size of a shilling, well steeled, with a short handle; rakes with iron teeth about two inches and a half in length, very strong, for raking out the large stones where the road is broken up, and for keeping the road smooth after being relaid and while it is consolidating; very light broad-mouthed shovels, to spread the broken stone and to form the road.

Telford's directions for repairing roads differ little from his instructions for forming roads. Where a road has no solid and dry foundation, he breaks it up, lays bare the soil, drains it, and bottoms with stones set by hand with the broadest end down, in the form of a neat pavement; over this foundation he lays on 6 inches of broken stones. Where a road has some foundation, but an imperfect one, or is hollow in the middle, all the large stones appearing on the surface of it must be raised and broken; and the road so treated

is then to be covered with a coating of broken stones, sufficient to give it a proper shape and to make it solid and hard. Where a road already has a good foundation and also a good shape, no materials should be laid upon it but for the purpose of filling ruts and hollow places in thin layers as soon as they appear; stones broken small, being angular, will fasten together. In this way a road, when once well made, may be preserved in constant repair at a small expense.

The best seasons for repairing roads are generally considered to be autumn and spring, when the weather is moist rather than otherwise. Although it is proper, Paterson remarks, at all times of the year to put on a little metal whenever any hole makes its appearance, yet in the drought of summer this will seldom be necessary. In summer the roads are less liable to cut; but if, at some places, a little fresh metal may be necessary, no more should be put on than is barely sufficient to bring these holes to the level of the rest of the road. Metal put on in the drought of summer does not soon bind together. Until such time as there is rain sufficient to cause them to bind, the stones will keep shifting and rolling about, and make a very unpleasant road to travel on. The most proper times of the year to put on any quantity of road metal are about the months of October and April, as the stones always bind best when the road is neither too wet nor too dry. When they are put on about the month of October they become firm before winter, and, with a little constant attention, the road will be easily kept in good order till the spring; and if it has been the case that the road has not been sufficiently attended to during the winter, and that it has got into a bad state towards the spring, by putting on fresh metal about the month of April,

sufficient to bring it into smooth surface order, it will be very easily kept in this good state throughout the summer.

Unmetalled Roads.—The central roads of the farm require to be hard roads. In many positions, however, where field roads are necessary to afford facility for transporting produce and manure, and for keeping the ploughing-engines off the cultivated land, broken stone roads would be too expensivo to construct, as they would be seldom used, and in such places burnt clay roads or even grass roads will be found to answer every purpose, especially where traffic upon them can be avoided in wet weather. On Mr. Prout's farm, in addition to hard gravel roads across the middle of the farm, communicating with the homesteads, there are two miles of grass roads, which were formed by simply ploughing and rolling, and then partially coating the top with small stones picked off the fields. These green headland roads are 10 feet wide, and from them the engines can cultivate every portion of every field without travelling on the land. Such roads cost very little to construct, and add immensely to the facility of working the land. These grass roads are very common in plantations, where they are found a great convenience on many occasions, such as in thinning and clearing out produce, in covert-beating, &c. In plantations, however, they generally require to have side-drains or open ditches, which are never necessary with field roads, and are the more expensive. Still, with side-drains 3 feet wide at the top and 14 inches at the bottom, and 2 feet deep, grass roads 18 feet wide can be formed at an average cost of 18*s.* per 100 yards. Burnt clay roads are much cheaper than broken stone roads, but will cost from 50*s.* to 70*s.* per 100 yards when laid a foot deep and 12 to

15 feet wide. They soon cut through with heavy traffic in wet weather; but where the traffic is light, and even with heavy traffic in dry weather, they are wonderfully durable. For carriage-drives the burnt clay or ballast makes a splendid road, as it is always smooth, is comparatively noiseless, and can be kept in repair without much trouble or expense. In the fen and clay land districts, where stones for road-making are often unobtainable, well-made ballast roads answer effectually for the heaviest traffic on the farm.

CHAPTER IV

PAVEMENTS.

PAVED roads, though common enough in towns, would be out of place on the farm; but on most farms there is some extent of pavement in or around the courtyards or stable-yards, where much trampling goes on, and common roads cannot easily be kept dry and clean. For such purposes pavements are very suitable in all country places.

Pavements as now laid down are of three kinds—stone, wood, and asphalte.

Stone Pavements.—The best stone pavement is one of rectangular blocks set in contact on their longest edges across the road, and resting on a foundation of concrete, or rubble-stone filled in with concrete. The blocks should not be more than 3½ or 4 inches broad, measured along the road; 9 to 12 inches long, measured across the road; and 8 to 10 inches in vertical depth. The Belgian pavement, in which the blocks more nearly resemble a cube, varying from 5 to 7 inches on each side, is but little inferior to the above if the foundation be equally good. For paving farm-yards, however, smaller stones are often preferred, and they are usually set in sand and well rammed. When the blocks, whether rectangular or cubical, rest on a sand foundation, they should all be equal in bed-area to prevent

unequal settlement. In some instances the paving-stones have been set on concrete, with the joints grouted with lime and sand, to insure a great degree of stability. Telford recommended a bottoming or foundation of broken stones, 12 inches deep; and he used paving-stones 4 to 6 inches in width, 7 to 13 inches in length, and 7 to 10 inches deep. The 6-inch wide paving-stones have been generally abandoned in favour of narrow ones, 3 or 4 inches in width.

Stones in a common pavement are usually somewhat oval, and they are laid either in parallel rows in the road (Fig. 8, *c d*), or alternately (*a b*) as bricks are laid in a wall. "On the first sort of pavement," Edgworth observes, "wheels slip from the round tops of the stones into the joints between, and some wear away the edges of the stones and their own iron tire. By degrees channels are thus formed between some of the stones, and in time the pavement is ruined." On the second sort of pavement (*a b*), where the stones are placed alternately, the wheels are prevented from forming grooves, and all the more so when the stones are small and are compactly laid.

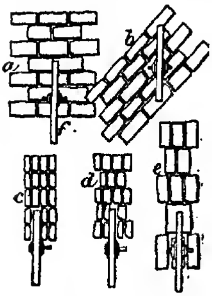


Fig. 8.

Wood Pavements.—Wood is now extensively employed for paving purposes, and for courtyards is much superior to stone, being less in first cost and more noiseless. The wooden pavements are formed of blocks of fir-wood, 3 to 4 inches broad, 8 to 14 inches long, and 6 to 8 inches deep. The blocks are set on their longest edges close together across the road, with an open joint about ¾ inch wide between the course. The

blocks should rest on a well-constructed bed of sand or a layer of boards. Wood blocks would soon be destroyed by crushing if set upon a rigid, inelastic foundation. The wood should be creosoted to prevent early decay; and the resistance of the wood is most effective when the fibres are in a vertical position, and least effective when they are horizontal. The open joints are filled with a mixture of prepared coal-tar and sand or gravel, and a small quantity of sharp sand is strewed over the tar. In some recently-formed pavements the blocks of wood are set upon a carpet of tarred felt, the latter laid upon a prepared bed of sand, and a strip of tarred felt is placed, edgewise, between the courses.

Asphalte Pavements.—Asphalte is largely employed for paving streets in London, its advantages being that it produces no dust and therefore no mud, is comparatively noiseless, is impermeable to water, is smooth, and consequently reduces the wear and tear upon animals and vehicles to a minimum. A good asphalte pavement requires a solid foundation, preferably either of concrete or rubble-stone filled in with concrete. The asphalte covering may be natural asphalte rock derived from the Jurassic region on the confines of Switzerland, or it may be composed of asphaltic cement suitably prepared by refining natural bitumen, to which is added a calcareous powder to take the place of the amorphous carbonate of lime contained in the natural asphalte rock. It is usually applied upon the foundation in a continuous sheet of 2 or 3 inches thick, although it may be used in the form of a rectangular block prepared under heavy pressure. A distinction must be made between pavements of genuine asphalte, properly prepared, and all those patented imitations of or substitutes for it composed of wood-tar, coal-tar, pitch, resin, &c., mixed

with either sand, gravel, ashes, lime, &c., or with two or more or all of them. These latter are unfit to support heavy traffic.

Comparative Merits.—The comparative merits of stone, wood, and asphalte pavements are as follows:—(1.) In point of durability, stone is first, asphalte second, and wood third. (2.) As regards first cost, wood stands first, asphalte second, and stone third. (3.) In respect to maintenance and repairs, the order of merit is first stone, second asphalte, and third wood.

CHAPTER V.

FOOTPATHS.

Good substantial footwalks, leading from the farmhouse to the steading, to the garden, and to the high-road, are comforts that ought to be enjoyed by every farmer and his family in their daily outgoings and incomings. Capital walks are made of large flat stones or flag-stones, but these are not everywhere obtainable, though they answer the purpose better than any other kind of material in clay districts. The most common material used for walks is small gravel, and next to that, perhaps, burnt clay; but for garden walks asphalte is now commonly employed.

Gravel Walks.—Whether the gravel is dug from a pit or is obtained from the beach or river bed, it should be well screened before hauling, and thoroughly freed from earth and dirt. The larger-sized gravel should at the same time be rejected. The rotary screen is a useful machine for preparing gravel for walks and road-making, as well as for screening ashes and artificial manures. It can be made to separate three different sizes—the very fine earthy matter, the large stones, and the fine gravel, the latter only being used for the walks.

The footpath should be 3 feet in width and 18 inches in depth, and before being excavated it should be lined out on both sides, and edged by means of a garden spade,

A section of a walk is shown in Fig. 9. The bottom is filled with broken stone or any hard rubbish, and 8 or 10 inches of the top are covered with fine gravel. To prevent earth mixing with the gravel, which will soon cause grass and weeds to grow up through the walk, the edges should be cut with a sharp spade as often as is necessary to remove any soil or turf that has encroached upon the gravel. When grass or weeds do appear on the path, the surface should not be loosened in the endeavour to eradicate them. They may be readily extirpated without injury to the walk by an application of common salt. On springy ground a

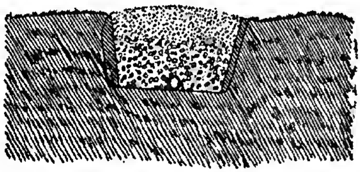


Fig. 9.

pipe-drain should be placed in the bottom of the walk, with proper outlets at the required points. The walks require frequent heavy rolling to maintain them in good condition.

Asphalte Walks.—The best walks of this kind are constructed of natural asphalte, applied in the liquid form, with a large proportion of sand. Artificial asphalte, which is obtained by mixing heated limestone and gas-tar, though possessing some of the properties of liquid asphalte, is a very inferior material, as it is brittle, and passes from the dry to the liquid state, and conversely, according to the weather. There are different mixtures of artificial asphalte in common use for walks, and these

are often variously applied. One uses 3 parts coal-ashes and 2 parts of gas-lime from the gas-works, thoroughly mixed together, and then made into a mortar with gas-tar. Another uses 3 parts of gas-tar and one of common pitch, melted together, and then mixed with sand as for common mortar. The mixture is laid on the surface of the walk 2 or 3 inches thick, a suitable foundation and

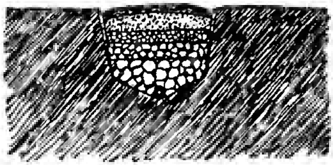


Fig. 10.

bottoming of broken stones having first been prepared. If a drain is needed, a pipe-tile is placed in the bottom of the broken stones; and by making the broken stones communicate with the surface at the edges of the walk, as shown in Fig. 10, the rain-water is readily admitted to the drain.

CHAPTER VI.

FARM TRAMWAYS AND PORTABLE RAILWAYS.

TRAMWAYS are now used to a considerable extent in and about farm steadings for such purposes as carrying turnips and fodder to the cattle, and for carrying out manure from the feeding-boxes and stalls. Fig. 11

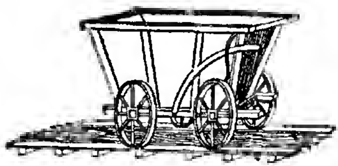


Fig. 11.

represents a tramway waggon employed in this kind of work.

The use of tramways and portable railways for farm purposes admits, however, of a more extended application. In an experiment exhibited by Mr. Wilkes before the Society of Arts, a moderate-sized horse drew, upon a railway declining 1 foot in 100, 32 tons easily, and 43 tons without much difficulty, dragging it down hill, and 7 tons going up hill, independent of the weight of the carriages. It was concluded from this experiment that upon a level tramway a horse could draw with ease 20 tons. The possibilities which tramways offer

for economizing horse labour on the farm will readily suggest their application to different purposes in many situations.

Where permanent tramways are not a necessity, and there is much irregular transit of produce or goods of any kind, Greig's Portable Railway may be used with great advantage. Its portability and easy adaptation to every description of traffic renders it absolutely indispensable in many situations.

The system may be advantageously used for clearing hay in irrigated meadows, thus preventing the destructive action of the wheels of heavily loaded carts. It is also extensively adopted by planters in the West Indies, Brazil, Australia, and other parts.

One of the most important items in the management of large agricultural undertakings is the cost and facility of transport. During harvest time, especially when dealing with heavy crops—such as beetroot, sugar-cane, &c., and for many other agricultural operations—it becomes more and more essential to secure ready means for removing produce and material in the most expeditious way and at the cheapest possible rate, and to save manual and animal labour as much as possible.

This is especially the case in connection with steam cultivation, which has provided the farmer with the means of dispensing with animal labour as regards the heaviest work hitherto performed by horses or cattle. If now, by some other mechanical means, the demand on this kind of labour for the purposes of transport can be reduced materially, the two most important and expensive operations of agricultural management will be freed from the necessity of animal labour.

Greig's railway is made in sections 15 feet long, each having one double and three or four single corrugated

steel sleepers. The plant is so light that a section can be easily lifted and moved by one man, and any labourer can relay it.

The principle upon which Greig's system is based is that of distributing loads upon a large number of wheels, and avoiding the use of heavy and cumbersome plant. The material to be removed is in most cases divided into loads weighing from 10 to 15 cwt., which are carried on small waggons, each having two axles.

If the material to be carried is of such a nature that it cannot be divided, or is too bulky for the ordinary waggons, small wheel bogies are employed, forming bogie waggons with bodies constructed in various forms convenient for the purposes for which they are intended.

By these arrangements and the many modifications which have been introduced, almost any description of load may be easily transported, and the waggons will pass freely around curves of small radii, even when loaded with material of great length.

The great superiority of this system of railway arises from the fact that the roads are rigidly secured to metallic sleepers, the jointing of the rail being also effected by means of steel chairs (which are rivetted to the sleepers) and clutch bolts of peculiar form, thus avoiding the drilling or puncturing of the rails and the use of loose fish-plates and bolts.

This arrangement ensures the line being accurate in gauge in all points without any adjustment, and this accuracy is maintained as long as the line remains in use.

The line may also be laid down and taken up very expeditiously without the exercise of skilled workmen.

It is impossible to enumerate the many purposes and trades to which this system of portable railway may be advantageously applied; but it is working successfully in cotton and sugar plantations and in other agricultural undertakings, farming and land reclamations, gathering beetroots, turnips, and other heavy crops.

Wherever there is material of any kind to be removed, this railway system will prove a valuable assistant in the work, and wherever it is adopted will effect a large saving in manual labour and horseflesh.

The railway is perfectly portable, since it can be laid down and taken up again without the help of any tool whatever. To give an idea of the facility of these operations where frequent removals are necessary, that is to say in clearing land of beetroot or sugar, &c., six men take up 250 yards of railway and relay them 50 yards farther on in twenty minutes, the line being moved in lengths of about 25 yards.

In order to enable our readers to form some idea of the economy of this plant, we give an extract from the letter of a sugar-planter in Cuba who is using it: "They began to put the line into the cane-patch on the 26th inst. about 2 P.M., and by 4 P.M. they had about 350 yards laid. By 7 P.M. they had drawn 64 waggons and one platform-waggon of cane to the mill with 6 oxen and 3 men. The waggon-loads weighed nett 8 cwt. 2 qrs. 2 lbs. each, and the platform-waggon carried a nett weight of 26 cwt. 2 qrs. 24 lbs. It would have taken 22 carts and 88 oxen and 22 men to have drawn the same total of cane by ordinary ox-cart loads. The labour of loading the waggons is very much less fatiguing than that of loading the carts. The waggons, both platform and ordinary carrier, run easily

on the well-laid fixed line, but the platform-waggons run more easily than the others.

Our illustration, Fig. 12, shows the portable railway in use on a sugar estate. Turntables are laid down at each crossing, and the empty waggons are pushed along by hand to the spot of loading, while the loaded waggons are drawn off the field by animal or by steam-power.

Cost.—The cost of the portable railway for animal-power lines varies from £307 to £342 per mile, or upwards, according to the gauge of lines and weight of rails. Shorter lengths can be had at from 3*s.* 6*d.* to 3*s.* 11*d.* per yard. The fittings and plant are extra.

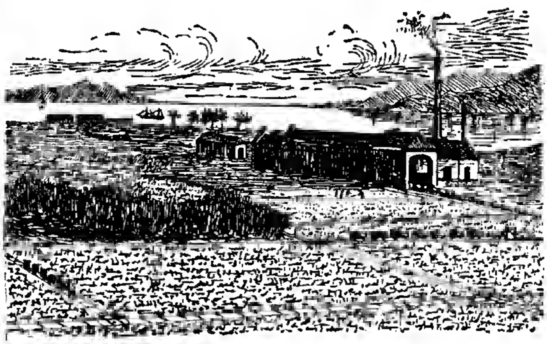


Fig. 12.

For locomotive-power lines, the cost varies from £468 to £518 per mile and upwards, with plant and fittings extra, and shorter lengths at from 5*s.* 4*d.* to 5*s.* 11*d.* per yard.

Portable Railways used in Steam Ploughing.—Instead of forming headland roads for keeping the heavy ploughing engines off the cultivated land, temporary rails may be laid down for the engines to travel upon,

as illustrated in Fig. 13. Mr. Osborn applied this system as early as 1846 to steam-ploughing in Demerara, where there are no roads on which the engines could travel, but the open drains presented an insurmountable

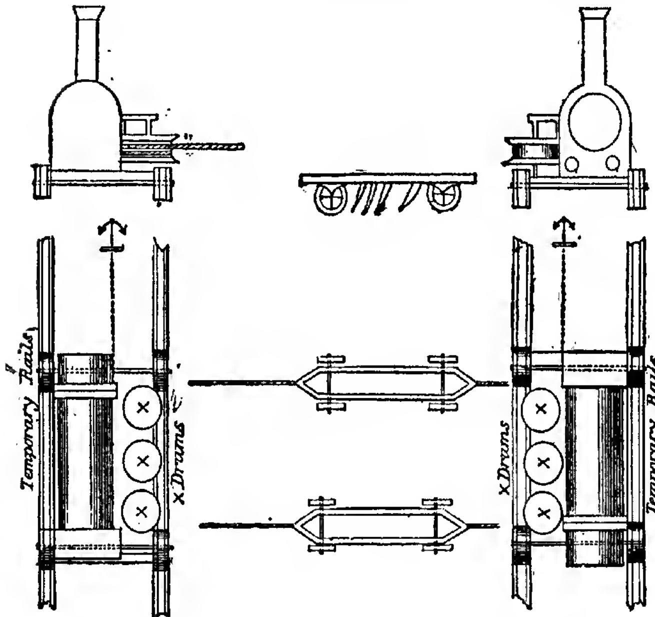


Fig. 13.

obstacle. There is no reason, however, why this system should not work well on English fields, and its adoption would greatly facilitate the employment of steam-power for tillage purposes, even on farms where there is a well-planned system of roads.

CHAPTER VII.

NAVIGABLE CANALS.

In flat countries canals afford great facilities, not merely as a medium of conveyance, but as a source of water for irrigation or the use of stock; so that, although the subject may not be accounted altogether agricultural, it would be improper in a work of this description to pass it over.

The great advantage of canals as a means of transport results from the weight which may be moved along with small power. "All canals," says Philips,* "may be considered as so many roads of a certain kind, on which one horse will draw as much as 30 horses on ordinary turnpike roads, or on which one man alone will transport as many goods as 3 men and 18 horses usually do on common roads." The velocity with which boats or punts can be drawn along a canal is, however, confined within very narrow limits, owing, as Edgworth has observed, "to the nature of the resistance to which they are exposed, this resistance increasing in a geometrical proportion as the squares of the velocity with which the moving body is impelled; whereas, on roads or railways, an increase of velocity requires only an arithmetical increase of power. Or, in other words, to draw a boat with ten times a given velocity would re-

* "General History of Inland Navigation.

quire a hundred times as much power as was required to draw it with that given velocity; whereas, to draw a carriage on a road or railway with ten times a given velocity would require only ten times the given power. For this reason, however advantageous canals may have been found for transporting heavy loads, they will be found upon trial inferior to roads in promoting expedition."

It is only in countries peculiarly circumstanced, like

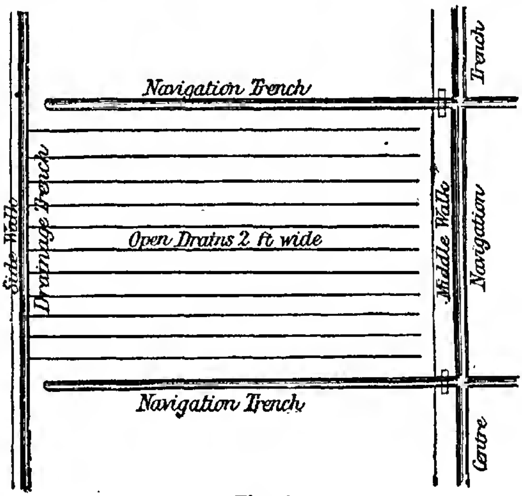


Fig. 14.

Holland or Guiana, however, that navigation canals are substituted for roads in the field transport of agricultural produce. And even in those countries it is questionable whether a system of portable railways would not be more economical in clearing fields, when we consider the great amount of land which is lost to cultivation by a complete system of agricultural navi-

gation canals. On the Demerara sugar plantations, where the whole of the heavy field transport is carried on by means of the navigation canals which surround every field, as shown in Fig. 14, there is a loss of some-like one-tenth of the whole land enclosed by these canals alone, and a greater loss—equal to one-seventh of the entire field—by the open drains which intervene.

Great, then, as the facilities are which a system of canals may offer in some respects, it is obvious that there is a limit to their multiplication where land is of much value. In Demerara the open drains interfere greatly with the economical working of the field canals, and add immensely to the difficulty of bringing a sugar-cane crop off the field after it is cut.

The cost of cane-cutting is calculated at 4 dols. per hogshead of sugar, and as the average yield is about two hogsheads per acre, the cost of cutting, which includes carrying out the cane to the canal sides, may be taken at 8 dols.

At present, however, owing to these open drains, the reaper has not only to cut the canes, but carry them to the parapet, where they are thrown down, to be lifted a second time by other hands engaged in loading the punts. Now there are from six to nine hundred bundles or head-loads of cane to an acre, and as the average distance walked for and with each bundle is 70 yards, it amounts to 30 miles travel in clearing an acre. Not ordinary travel either, for half of the way the labourer has to carry a load of 75 lbs., and to cross as many as 1,275 drains.

To be sure, there is Greig's system of clearing cane-fields, in which two ordinary ploughing-engines are placed on the opposite roads, their ropes being connected by a shackle, to which a spare chain is fixed. The

waggons are attached to this chain and hauled over the field from one engine to the other, being steered along the uncut edge of the sugar-cane and loaded at the same time. This system applies particularly to very large estates, and where constant employment is afforded for the machinery. Where the employment is not so regular, a cheaper system may be inaugurated. It is just possible that a wire-rope carrier might be employed with more advantage in cleaning the land and delivering the canes to the waggons on the central road.

On the present system, loading and transporting canes is reckoned to cost 1 dol. per hogshead, but the actual cost is a great deal more. In order to show this with some accuracy, we may here take into account the different items of expense in this consideration. To load and pick up the canes costs not less than 12 cents per punt, and as it takes 6 punts or so to the hogshead of sugar, this amounts to 1 dol. 44 cents per acre. The lowest possible number of punts in use on a large estate will be one for every 25 acres of crop. Now the first cost of a wooden punt is at least 80 dols., interest on which at 5 per cent. is 16 cents per acre; and as the wear and tear is equal to about 12½ per cent., the use of the punts may be said to cost 56 cents per acre. There are also the punt mules to be considered. The annual expense of a mule is as follows:—

Feed and attendance	40 dols.
Harness	3 ,,
Interest on capital	5 ,,
Risk	10 ,,
	58

If, then, there are two mules for every 100 acres in canes, the expense will be 1 dol. 16 cents per acre. A driver at 3 cents per punt is 36 cents per acre more. And,

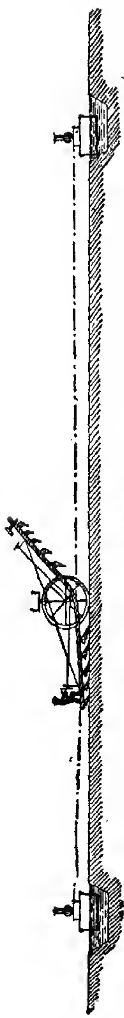


Fig. 15.

lastly, there are navigation trenches to be kept in repair. It is rather below the mark to say that there are 9 rods of trench per acre to be cleaned or weeded once a year and dug bi-annually—say weeding at 2 cents, and digging at 16 cents, per rod—in all amounting to 90 cents per acre. Transporting, therefore, must be taken at 4 dols. 42 cents per acre.

We make no doubt that this could be done at considerably less cost by a system of roads, and still more economically by means of the portable railway, if a system of covered drains prepared the way; but of course where canals are already constructed, it will in most cases be advisable to adhere to them, notwithstanding the loss of ground they occasion, until such time at least as land becomes so valuable that no part of it can be permanently left out of cultivation. In laying out new estates, however, there is no such consideration to prevent the immediate adoption of the transport system, which is the most economical both in its working and in its contingent effects.

Ploughing with Engines in Punts.—This plan of working was originated by McRae, on the Demerara fields, in 1839; but the machinery then available was cumbersome, and, instead

of two engines being employed, there was one engine in one punt, and an anchor in the punt on the opposite canal. Fowler's direct double-engine system of steam cultivation is now practised on several estates in the colony, with both engines in punts, as shown in Fig. 15. The fields so cultivated have been previously tile-drained, and had the old open drains filled up. Cultivating from canal to canal entails working across the shortest length of the field, which is only from 165 to 178 yards, whereas the length from the middle walk to the side-line dam is never less than 550 yards. The former lengths are too short for economical working, from the number of turnings involved, and the only remedy would be to double the distance between the engines, by filling up every alternate canal; but this would necessitate the adoption of some other method of clearing the fields than that of the labourers carrying out the sugar-canes by back-loads, as is now done, for the distance between the punt-trenches is already too great for that.

CHAPTER VIII.

ENCLOSURES.

In the pastoral state of society men wandered about in communities and fixed their abode only where they could obtain pasturage for their live-stock, their sole occupation that of tending their flocks and herds. Attached to a convenient spot they probably made an enclosure, suited to the number of their live-stock, near their own dwellings, to confine them during the night. This enclosure would serve the double purpose of relieving the night watches of the shepherds and of protecting the live-stock against the attacks of wild and ferocious animals.

A similar practice followed the first attempts at cultivation. The cultivated land was near the dwellings, and was surrounded by a single fence; and hence the origin of the ancient mode of subdividing land into *outfield* and *infield,* a practice which was continued till later times and more enlightened ideas swept the distinction away, and the ancient *ring-fence,* which only surrounded the cultivated land, was removed to the boundary of the farm. In flat countries subject to inundation, canals and ditches, for the purpose of extending the benefits of irrigation, were formed instead of fences.

There is no doubt that the only method of enclosing

land practised by the Romans was that of the ring-fence around the cultivated ground; and it is probable that this was the only mode known to the ancient Greeks and other nations.

Before the extensive use of fences, landed property was marked out by *stones* or *posts*, set up so as to ascertain the division of family estates. Such *land-marks* constituted the customary method of distinguishing landed property among the Israelites, and to remove them was a crime similar to altering, destroying, or concealing the title-deeds of estates at this day. The law of Moses denounces curses on those who remove their neighbours' landmarks. Even among the heathen the landmark was sacred—so sacred that they made a deity of it. The owners of both fields brought each his garland and libation to the honour of this god. They sung its praises, put on its top a chaplet of flowers, poured out the libation before it, and the inhabitants of the country held a festival in its honour. It was, in short, celebrated as the preserver of the bounds and territorial rights of tribes, cities, and whole kingdoms, and without its testimony and evidence every field would have been a subject of litigation.

Some such ancient ceremonials, it is curious to observe, are practised amongst ourselves at the present day. At Hawick, the marches of the landed property of the town are distinctly pointed out every year, in the month of June, by the magistrates, cornet, and a large number of the inhabitants, all on horseback, which procession, concluded by a civic festival, is called the "Common-riding." An old song, annually sung by the inhabitants on the occasion, dwells with spirit on "Our marches rode, our landmarks planted"—a formal demonstration of their legal rights which was doubtless

really necessary in ancient times, when written documents were in constant danger of being destroyed. At Selkirk, another royal burgh, as the burgesses in procession annually ride the marches, the town miller comes forth with cakes and other offerings, as, it appears from Juvenal, was done amongst the Romans of old, whose offerings of cakes, first-fruits, and flowers were, however, made to the sacred *termini*, or landmarks, and not to the citizens who were patrolling the bounds of their "known inheritance."

> "Those bounds, which with procession and with prayer
> And offered cakes, were made their annual care."

The ancient mode of enclosing land is still practised by many of the modern nations of Europe. In France property is so much sub-divided, by the extinction of the law of primogeniture, that no field enclosures are to be observed in that country—a few march-stones, a row of trees, or particular single trees here and there, marking the boundaries of estates. Nearly 6,000,000 transfers of property take place annually in France, and they are made with such uncertainty as to boundaries as to lead to numerous disputes, no less than 22,000 out of some 45,000 civil causes tried yearly relating to succession of property. Throughout Germany, Italy, Spain, and Switzerland, enclosures are only found near farmhouses and villages, the bulk of the corn being raised on extensive unenclosed grounds. In Holland and Belgium, on the other hand, the land is so much enclosed that the fields appear half choked with hedgerow-trees and hedges. In some parts of the South of England, also, much valuable ground is occupied by over-numerous and often sadly overgrown and neglected hedges; while in Ireland land is much sub-divided by turf dykes.

The size of enclosures must be regulated by the system of cultivation pursued, and by the extent of land undergoing the rotation; but these requirements should be made to harmonize as much as possible with the local considerations affecting the utility of fences, particularly the conditions of climate and shelter. Shelter is required both against heat and cold, and its attainment should be studied in the formation of enclosures. Trees form the best protection, and where they are obtainable no other shelter is required, and the advantages in such situations will always preponderate in favour of large enclosures and open fences. In elevated districts, exposed to the force of the wind and destitute of trees, a compact fence is all the means of shelter at command, and therefore, within a certain limit, their increase will prove beneficial. But in low-lying ground, well sheltered by trees or by the natural configuration of the surrounding country, there is practically no other object requiring the formation of a fence than its primary use of providing an efficient enclosure for grazing purposes. In such districts the utilisation of fences for shelter should be carefully guarded against, both because they are unnecessary for such a purpose and because their effects are hurtful alike to the climate and to the surrounding soil, and, consequently, injurious to the crops. This is especially the case when the enclosures are of small extent.

The broad hedgerows which are to be seen in many parts of England, composed of a belt of trees flanked on each side by a hedge, and having a dense growth of underwood, are positively injurious to the land. No doubt the object of cultivating these hedgerows (if there is any definite purpose in view at all) is the double one of providing for the growth of firewood and

of securing shelter. But, if the intention is good, the results of making a plantation out of a fence are neither satisfactory nor profitable. They prevent the soil from drying quickly if it is naturally damp, and, by the stagnation of the air which they induce by obstructing the free flow of the atmospheric currents, they poison all the surrounding grass and crops. They are also complete nurseries for weeds, and afford shelter for insects, vermin, and such birds as are destructive to crops, from which cause the headlands of the fields are generally quite lost to the farmers; and there is the additional loss of the ground occupied by the superfluous width of the hedgerows themselves.

A fence should always be as narrow as possible, consistent with due fitness for its purpose. The space required will, of course, vary according to the different kinds of fences used; but in a hedge, for example, which occupies more space than any other system of fencing, there is seldom any reason or necessity why the width should exceed 3 feet. The economy of guarding against excess of width in fences is very apparent by a simple calculation. If we allow a hedge to occupy a width of 2 feet, and cultivate the ground on each side to the distance of 3 feet from the centre of the fence—which allowances are certainly very far short of the real practice throughout the country—we should find that on a farm of 250 acres, laid out in 25 fields of 10 acres each, there is an area of more than 4½ acres, or a 55th part of the whole, entirely lost to cultivation through the use of fences.

It is generally admitted that fields which are surrounded by hedges are more fertile than those which are unenclosed; but this is not universally true without limitations. In dry situations and on light sandy

soils they are undoubtedly of great benefit from their effects in preventing the escape of moisture, and, therefore, in such places their value will, in some measure, increase in proportion with their number. But, on the other hand, these same effects must be injurious to a soil which is naturally damp and moist, if the hedges abound in number.

There are a great many different kinds of fences now in use, but all those of any importance will be noticed separately in the following chapters.

The great expense of erecting new fences and of repairing old ones is a good reason for having as few of them as possible.

A common light wire fence will cost at least 8*d.* per lineal yard, or £58 13*s.* 4*d.* per mile. To enclose a farm of 640 acres (1 square mile) in a ring-fence, will therefore entail 4 miles of fencing, at a total cost of £233 13*s.* 4*d.*; or, assuming that adjoining occupiers share half the cost, £116 16*s.* 8*d.* If this farm is subdivided into fields of 20 acres, there will be 32 fields, entailing 10 miles of interior fencing—making a total of 12 miles, *and involving an outlay of £704,* or *£1 2s.* per acre. The above estimate is *certainly not overdrawn.* The cost of almost every other description of fence would be greater, and there are few farms where tho fields average 20 acres. It must also be remembered that over and above the first cost there is the expense of maintenance and repairs, not to mention the loss of land occupied by the fences. If we take 12 per cent. per annum on the capital sunk in fences to cover interest, maintenance, and repairs, it amounts to 2*s.* 8½*d.* per acre; and if the loss of land is 2 per cent. on 640 acres, there are 13½ acres, which, at an annual rent of 20*s.* per acre, adds another 4½*d.* per acre

over the farm, making the total annual cost of fences 3*s*. 1*d*. per acre.

The cost of keeping a large farm well fenced into many fields is very considerable; but, when viewed collectively, the amount of capital employed in the construction and repair of fences in this and many other countries is simply fabulous.

There are 45,000,000 acres of enclosed land in the United Kingdom; so that, on the foregoing estimate, the capital sunk in fences must be nearly £50,000,000, and their annual maintenance and repair must cost at least £6,750,000.

The common fences which divide the fields from the highways and separate them from each other, are, it is seen, one of the greatest investments in this country, albeit an unproductive one.

Some systems of farming do not require that inside fences should be kept up; but there is always an advantage in having the farm laid out in fields, even when there is no necessity of erecting fences on the dividing lines. The crops themselves show the boundary of each lot. Moreover, the measurement of every field should be known, for convenience in estimating the quantities of seed and of manure to be used, of tillage and labour to be expended, and of produce to be reaped.

CHAPTER IX.

HEDGES.

Quickset Hedges.—There are a great variety of plants used in the cultivation of hedges, but the plant which is best adapted to the purpose is whitethorn or hawthorn (*Cratægus oxyacantha*), also called quickset. It is almost the only one which produces a good fence of compact growth, and of all others its use is attended with the fewest disadvantages. It can be managed so as to form a compact and equal fence, and yet occupy very little space. Its roots do not throw out new ramifications into the surrounding soil; it stands the severest winter without injury, and, on account of its thorns, it is avoided by all animals, and does not harbour birds and insects, unless it is allowed to spread out its branches to an unnecessary extent.

Season of Planting.—Thorns are planted in a hedge from autumn, when the leaves drop off, till spring, when the buds begin to swell, unless in frosts and heavy rains. When planted about October the plants are said to be more healthy than if put in at any other time, and there is undoubtedly this to be said in favour of planting then, that if the winter proves mild new roots are produced, which form a good preparation for a vigorous growth in spring. But this is a point on which all are not

agreed, as some think that it is safer to defer the final transplantation till the spring, when there is no danger of the plant being injured by frost.

Plants.—The plants should be put in the ground immediately upon their removal from the nursery-bed. The roots should be left as entire as possible, but the ragged parts should be cut away with a knife, and the head lopped off to make the plant grow bushy. If the wounded parts of the roots be cut into small pieces, and sown in a bed prepared for them, they will produce quicks or thorns the same year, and such a method of propagation is more expeditious than that of growing them from the seed.

In planting hedges it is common to use plants of one, two, or three years old, seldom exceeding this last age. Such young plants, however, are long in growing into a fence, and would be totally destroyed in the interval if not well fenced and nursed. Much time might be saved in the rearing of hedges, and good fences obtained at less expense, if older plants were employed for that purpose. Three years old is certainly the youngest that should be planted, and if they are even six or seven years old so much the better. The prevailing idea that plants of that age will not thrive if transplanted is totally unfounded. In Holland the nurserymen have ready-grown hedges for sale; and these being frequently removed from one spot to another may, almost without hazard of failure, be transferred to a considerable distance and replanted.

Methods of Planting.—A hedge should be planted on the flat, as in Fig. 16, because the thorns, when planted erect, grow sooner into a useful fence, and much less ground is wasted when they are placed in their natural position than when laid sloping. There should be no

ditches about a hedge, unless they are actually needed for drainage.

The old bank-and-ditch methods of planting were very expensive, and less successful. In these cases the hedge was planted either on the flat of a bank or on the face or slope of it. A ditch 2½ feet wide at top and 1 foot at bottom, and from 2 to 3 feet in depth, was thrown out and formed into a hedge-mound alongside. When the hedge was to be planted on the flat of a bank, the mound had to be levelled, as in Fig. 17; when

Fig. 16.

Fig. 17.

Fig. 18.

Fig. 19.

to be planted on the face or slope of the bank, the mound was shaped as in Fig. 18. Sometimes a double hedge and ditch was formed, as in Fig. 19. Planting on the flat of a bank is, perhaps, the worst of all methods, because not only is the thrown-up soil apt to be poor, but the plants are sure to suffer from want of moisture in dry weather.

Preparation of Soil, and Planting.—Before planting on the flat, the soil in the line of the hedge must be carefully prepared by loosening it to a depth of at least

a foot, and ridding it thoroughly of weeds. On poor soils it will be found of great benefit to apply a little garden-mould or well-prepared compost around the roots of the young plants.

The quicksets should be planted at distances of from 6 to 10 inches asunder, according to the quality of the soil, in single rows or in two rows, as . · . · . · . · . · In a good soil there is less difficulty in rearing them, and, consequently, fewer plants are necessary.

Weak plants should not be mixed with the strong ones in a hedge, but kept separate, so that special care can be devoted to them. When the two are mixed, the weaker are impoverished and choked up by the stronger.

It is a pernicious practice, that of planting trees in the line of a hedge. Most trees (such as the oak, beech, and elm) grow faster than quicksets, and when grown in the midst of a thorn hedge spread their roots in all directions, robbing the thorns of their proper nourishment, and soon overshadow them and deprive them of the benefits of sun and air.

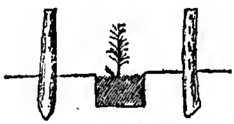


Fig. 20.

Fencing Young Hedges.—The hedge while young must be properly fenced to protect it from injury by animals. This may be done by erecting a double row of posts and rails, four rails in height, after the manner shown in Fig. 20. In some cases a single protecting fence outside the hedge will be all that is necessary. Cheap wire fences are often employed for this purpose instead of posts and rails. Frequently, also, a double or single *dead-hedge* is formed to serve as a fence and guard, until the quicksets are grown; in the latter case the quickset may be wattled into the dead-hedge.

Weeding and Cleaning.—The roots of the young hedge should also be kept carefully clean, and the soil around them occasionally stirred. For digging around the roots of the plants a small spade is used, and for stirring and weeding the surface under the hedge the Dutch hoe is commonly employed.

Fig. 21.

Pruning.—During the first year or two, the top of the hedge should be moderately pruned, and the lateral branches suffered to grow untouched. It afterwards becomes necessary to cut them, but they should be left as bushy as possible at the lower part and gradually tapered towards the top. The triangular section, as illustrated in Fig. 21, is proved by experience to be the best form of a hedge, as it approaches most nearly to the natural form of the hawthorn tree, and may be grown to a height of 4 or 5 feet without ceasing to be thick and well-clothed to the very bottom; and such a hedge forms a pleasing, impenetrable, and durable fence.

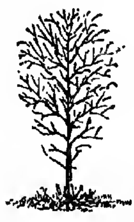


Fig. 22.

When the converse method of training is adopted, and the hedge is allowed to grow bushy at the top, the plants are almost branchless near the ground, as seen in Fig. 22, and the older this fence becomes it gets more and more useless.

Trimming a Hedge.—With a hedge-bill or switcher, a man will trim a great quantity of hedge in a day. This instrument is light, and easily wielded. The hedger walks forward to his work, close alongside the hedge, with the switcher in his right hand, and uses it with a single upward stroke, from the lowermost to the highest

twigs or branches. The left hand is used as a catch or rest for the bill as it descends.

Brush Fork.—For lifting and handling hedge cuttings, a common spreading-fork is sometimes fitted with a board 2 feet long and 6 inches wide upon the handle. This prevents the cuttings from sliding down the fork-handle, as they are otherwise apt to do when the fork is raised upon the shoulder.

Ditching.—When there is a ditch about a hedge, it should be cleaned out or re-dug, and the hedge-bank repaired, at the same time that the hedge is pruned.

Repairing Old Hedges.—On favourable soils quickset hedges, if carefully trained and occasionally cut over or dressed in the wedge shape, will last good for ages. If their original training has been neglected, however, they soon become full of gaps and weak places, in which condition they are an everlasting trouble.

In ordinary-sized gaps between the old stems of a thorn hedge young plants will not easily take root and thrive. This effect is produced partly by the old hedge over-topping and shadowing the young plants, and sometimes partly by the want of nourishment from the soil, the older roots having already extracted much of the elements of fertility.

Plashing.—Gaps in hedges may often be filled up by laying down a long branch or stem of thorn, half cut through near the ground, and fixing it firmly along the surface by notched stakes driven into the ground, and covering the extreme end with a shovelful of earth. This extreme end strikes root, and the horizontal stem or branch throws out upright shoots, which fill up the gap. This, after a short time, makes a good interim fence; but, in the long run, plashing is destructive to the plants, and accordingly there is scarce to be met

with a complete good hedge where it has been long practised.

Dead-Hedges.—A better plan of cutting over an old hedge, when there are no gaps, is to cut it close to the ground, and make a dead fence for the temporary purpose of protecting the young shoots which will spring up from the old stumps till they have acquired a sufficient degree of strength to render them fencible without any other assistance. For this purpose the dead-hedge is well adapted, and lasts so long as to enable the live fence to grow up and complete the enclosure.

Dead hedges are of different sorts. Plain dead-hedges are made by cutting the thorns or brushwood of which they consist into certain lengths, and planting them with their but-ends in the ground. These are called plain dead-hedges, in opposition to other descriptions, where more art is used, such as the dead-hedge with upright stakes, wattled, Fig. 23, and the common plaited hedge, bound together at the top with willows.

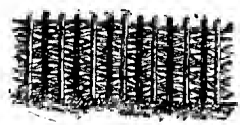


Fig. 23.

The Stake-and-Rice fence is another form of dead-hedge, and is formed of stakes driven into the ground 5 or 6 feet apart, and interlaced with branches set on their but-ends in the direction of the heaviest winds, and each one wound alternately before and behind the stakes. A single rail is often nailed along the top of the stakes as a finish and to afford additional strength to the fence.

Wiring an Old Hedge.—The great drawback to old and badly grown hedges is their want of lateral branches near the ground, sufficient to make it close enough to turn small animals, such as sheep and pigs.

This defect may be remedied without cutting over the hedge by making a combination hedge-and-wire fence, as illustrated in Fig. 24. If the old hedge is very high and shelter is not needed, it may be topped down in the manner shown in Fig. 25.

This method of wiring an old hedge near to the ground, gives an efficient fence, and at considerably less cost than by cutting over and plashing and forming a dead-hedge or other temporary fence to last till the old hedge is re-grown. Wooden rails are sometimes used instead of wires, but the latter are preferable, being more portable, and at the same time cheaper and more durable.

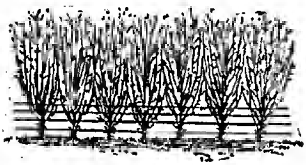


Fig. 24.

Fig. 25.

Other Hedge-Plants.—Amongst other plants used for hedges are hornbeam, holly, willow, whin or furze, hazel-nut tree, common birch, narrow-leaved English elm, beech, prickly broom, and privet. Hedges are sometimes formed of one of these species only, but often of several mingled together, as of beechwood and privet. None of these plants, however, makes a good hedge for field purposes, as they are either very slow of growth and require a long time to attain a sufficient height for a fence, or else when grown it is not sufficiently defensive at all seasons and will not stand pruning.

Whin Hedge.—The common whin, furze, or gorse, an indigenous evergreen, armed with spines, was formerly much cultivated as a fence-plant, and is so still in some situations. It comes very quickly to perfection, and

grows in a soil where few other plants would thrive. The whin-seeds are sown when the ground is fresh and moist, at the rate of about 1 lb. of seed to 200 yards. The best season for sowing is during the months of March and April.

The old method of growing a whin-fence was to sow the seed on the top of a bank. It is best cultivated on the flat, however, for the same reason as the quickset; and the ground should be prepared previous to sowing the whin-seed, the same as directed to be done before planting a quickset hedge.

The whin forms a complete fence the second year after planting. The hedge should be pruned once a year, in the month of June. On attention to this the permanence of the fence very much depends.

Being one of tho cheapest fences, and the plant having such facility of growth and fitness for the purpose, it may be asked why the whin is so little grown as a hedge-plant? The chief reason is its want of durability; for although a native plant, and, under certain circumstances, hardy, it is very liable to be destroyed by frost. It cannot, therefore, be depended upon as a permanent fence. Its duration, indeed, can be greatly prolonged by regular pruning, but under the best management it makes a comparatively short-lived fence.

Hornbeam Hedges.—In Germany they plant hornbeam in such a manner as that every two plants may be brought to intersect each other in the form of a St. Andrew's cross. In that part where the two plants cross each other the hedger gently scrapes off the bark and binds them with straw thwart-wise; here the two plants consolidate in a sort of indissoluble knot, and push from thence horizontal shoots, which form a sort of living palisado or *chevaux-de-frise.*

Willows, when grown as a hedge, are also planted cross or lattice-wise, and bound along the top.

Osage Orange Hedges.—In some parts of the United States the osage orange is much grown as a hedge-plant, but though it is a rapid grower and shoots up erect, it is so open below that it is worthless as a fence against sheep and pigs, and even small cattle, unless it is wired or railed near the ground.

CHAPTER X.

DYKES OR WALL FENCES.

Since hedges are not available for use as fences until they are several years old, they must be left out of account where an immediate fence is wanted, unless the Dutch plan of planting ready-grown hedges be adopted. Moreover, in those districts where the greatest proportion of land has to be reclaimed, both soil and climate are unfavourable to the satisfactory rearing of hedges. In such places, however, stone is generally abundant, and can be used in the construction of dykes, which are better adapted to a high country than any other description of fencing.

Lime-built walls, owing to the great expense of them, can only be of limited application on the farm, but dry-stone dykes can be erected at a moderate cost. Where lime is abundant it is a good plan to set the cope-stones in mortar, for if the wall is well constructed the top stones, which are the most liable to be moved, are thus firmly secured.

A dry-stone dyke may be considered a permanent fence, because the materials never decay, and it has this advantage as compared with a hedge, that it is of immediate use. A well-built dyke will stand many years without requiring any repairs, and with a little

expense in later years to keep it in order it will last a whole generation without requiring to be rebuilt.

When the stones are dug out of the ground, especially if they are of a gritty or brittle nature and show a tendency to split, they should be carted to the site of the dyke in the autumn and left unbuilt until the spring. They will thus be subjected during winter to the influence of frosts and of the atmosphere, the effects of which will be the disintegration, complete or partial, of the undurable stones, which can be thrown aside at the time of building, The neglect of this precaution often shows itself in the crumbling down of comparatively new-built dykes, and the builder is generally blamed for carelessness in neglecting to pack or pin his work sufficiently, when in reality the blame consists in providing him with bad and untried stones.

A dry-stone dyke on arable ground is generally built about 4 or 4½ feet in height. On hilly ground, where it is intended as a fence against sheep, and shelter is much needed, it should not be less than 5 or 6 feet high. The dimensions for a dyke 5 feet in height are about 27 inches broad at the base and 14 inches at the top. The foundation-stones should be large, and the inequalities of the ground should be smoothed with a spade, so as to provide a solid bed before they are laid. A selection of stones is not always possible, but where they are available those of a flat shape with a rough surface should be chosen, as they are laid on their natural beds and do not require pinning. Small stones are useful, and indeed necessary, where materials are undressed, but the builders should not be allowed to pack them all into the heart of the wall. Such a practice leaves the wall without bond, and unfit to stand for any length of time. The large and

small stones should be uniformly mixed throughout the wall, so that in every part of it they may break bond as much as possible. There should also be one or more through bond-stones in the height of the wall, built in at every few feet of the length. The body of the wall is surmounted by a flat cover, on which the cope-stones are set on edge.

The quantity of stone required to build one lineal yard of a dyke 5 feet in height is 0·95 cubic yards, or

Fig. 26.

95 cubic yards of stone to every 100 lineal yards of dyke. The building alone, which is all the cost incurred when the stones have to be taken off the land, can be done for *7d.* to *8d.* per lineal yard; but the total cost, when the stones have to be specially provided (including quarrying, or digging them out of the ground when they cannot be obtained on the surface, carting them to the site, and building the wall), will be found to vary from about 1*s.* 3*d.* to 1*s.* 9*d.* per lineal yard. One man can build 6 yards of dyke in a day, working

by himself; but the work is best done by two builders working together on opposite sides of the wall, as by this method a better bond can be obtained than when the two sides are alternately raised. A wooden frame of the dimensions of the dyke is used as a guide by the builders. This description of fence, and the method of building it, is shown in Fig. 26, the illustration being a reproduction from Stephen's "Book of the Farm."

Haulage of Stone.—When the stones are quarried on the ground, or can be gathered off the field, they are easily conveyed to the site of the dyke upon a stone-boat or sledge. This is particularly the case when the loads have to be drawn down hill and on steep ground, where wheeled vehicles are employed with difficulty and inconvenience. Moreover, the stone-boat is easier loaded and unloaded with large stones than a high-sided cart.

Galloway Dyke.—The Galloway dyke owes its name to the circumstance of its having been originally introduced into use in Galloway. It is built without the use of lime or mortar, the same as the dyke already described. Two-thirds of its height, from the surface upwards, is regularly and evenly built on both sides, well filled-in, or packed in the heart, and tied or strengthened at short intervals by long stones reaching from side to side, called thorough-bands. When this first portion of the wall is finished and regularly levelled at the top, the upper third of its height is built of long rough stones, laid across the wall or dyke, having firm hold of each other laterally, but not packed in the heart, the largest stones used in the lowest course, and gradually diminishing to the top. A few inches of additional height in the open work of the Galloway dyke adds very little to the expense.

If well-built and of durable materials, the Galloway dyke will stand good for 20 years without need of repairs. It is peculiarly well adapted as a sheep fence for the Highlands, or all mountain pastures; but it is less suitable for low ground and as a fence against cattle.

Turf Dykes.—Where stones and timber are scarce and expensive, a turf dyke is sometimes of service. Fences of this class are not unfrequently erected as plantation fences in preference to others, chiefly on account of the material they are formed of being found ready to hand on the spot. Mr. C. Y. Michie, who, as forester to the Earl of Seafield, has had large experience in the erection of turf dykes around new plantations, informs us that his practice is as follows:—"On commencing to erect a turf dyke a line of poles is set along the centre of the line of fence, from which the basement is marked off on each side two feet, the whole base of the dyke being 4 feet. The height of the dyke above the ground surface is 4 feet, and its width on the top 20 inches. A ditch 4 feet wide at the top, 2 feet wide at the bottom, and 2½ feet deep, is usually formed on the front or outer side of the dyke. The turfs of which the dyke is built are cut 8 inches broad and as deep as the soil will admit, and are set on edge with the grassy side outwards, their position corresponding with the slope of the dyke. After the first row of turf is set up as much earth is excavated from the ditch and thrown to the back as will level the surface fully as high as the top of the turf. After the backing is firmly packed and levelled, another layer of turf is set up, and the same process of filling and levelling again repeated, observing always that in placing the turfs the joinings do not come opposite each other. The cost of building a turf dyke

of the dimensions given is from 6*d.* to 7*d.* per lineal yard."

The turf dyke is often constructed in a hasty and careless manner, in which case it soon moulders down. When the sods are carefully cut and attentively laid, each course made to cover the seams or joinings of those immediately below, together with ties or thorough-bands at frequent intervals, and the whole properly packed in the heart, with a sufficient coping of long sods on the top to keep out rain, this fence is tolerably durable.

When the turfs are set on edge instead of laid flat, the dyke lasts considerably longer without requiring to be rebuilt. The best and most durable turf for dykes is that which contains most solid earth; and the least durable that which contains most vegetable matter. After laying it up in heaps for a time the latter becomes a decomposed, soft, and pulpy mass. This change is especially apt to take place with turf in a dyke if laid in a horizontal position, one layer above another.

Frequent repairs are necessary, but if these are carefully executed every spring, and when any breach occurs, the turf dyke will occasionally answer a good purpose in particular situations, more especially as the original expense is very low.

CHAPTER XI.

WOODEN FENCES.

OPEN wooden fences are less suitable to a high, open country than hedges or stone dykes, but in a low country they have many advantages to recommend their use. They occupy very little space, and are favourable to a free ventilation—two points which deserve special attention where land is valuable, and in thickly wooded districts. The chief objection to their use lies in their temporary character, which arises from the liability of the materials to decay, and often also from defective and unsubstantial construction. Yet as a protection to young hedges, in districts where timber is plentiful, a wooden fence is often more economical than any other.

Wooden Paling.—The common wooden paling consists of horizontal rails nailed to posts or stakes placed vertically and driven into the ground, as shown in Fig. 27. It may be made with either three or four horizontal rails. The latter number is preferable and necessary where sheep are feeding.

The rails are formed either of sawn or split wood. When the trees are small they may be split, but when they are of sufficient size they should be sawn.

Larch, spruce, or any other kind of fir or pine-wood, is commonly used, but larch is best, especially for posts, unless they are of hard wood. The posts are made about

6 feet long, and sharpened to a point. They are driven into the ground with a mall, to the depth of 8 inches, and set 6 feet apart. The horizontal rails are nailed to the posts.

A paling of larch-wood, having posts 6 feet apart, and four rails in height, can be erected at a cost of about 3*s.* 6*d.* per rod, or 7½*d.* per lineal yard.

Preservation of Wooden Posts.—It has long been a practice to burn or char that part of the posts or standards intended to be set or driven into the earth, as a means of rendering them more durable; but the best defence against the decay of the posts is to leave

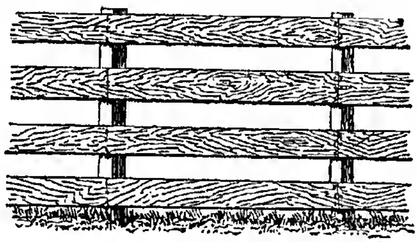


Fig. 27.

the bark on at that part which is to remain immediately above and below ground. Other remedies are also employed at times to prevent the decay of the posts—such as dipping the points that are to be driven into the earth into a solution of boiling tar, melted pitch, or *gas-liquid.* *A friend of ours* gives the following recipe: "Take boiled linseed oil, and stir in pulverized coal to the consistency of paint. Put a coat of this over the timber, and there is not a man alive that will live to see it rot." The posts should be completely dry before they are dipped in any of these preparations; for if they are either made of green wood, or have imbibed

much moisture, the expansion of the moisture will bring off the coating; whereas when they are made of well-seasoned wood, and are at the same time perfectly dry, and the pitch boiling hot, it readily enters the pores, and, by filling them completely, prevents the access of moisture, and consequently the injurious effects caused by it.

Driving Fence Posts.—All the posts should be driven into the ground deep enough to be beyond the risk of their being lifted by frost. This attention is especially needful on soils that are liable to heave.

The usual method of driving fence-posts and stakes is to strike them on the upper end with a heavy wooden mall; but in the operation many of them get split at the top and are soon destroyed. To drive the posts without injury, use a piece of hard wood scantling, 12 inches long by 6 inches broad, with a handle 3 or 4 feet long attached to it. A boy lays this scantling on the top of the post to be driven, and retains his hold on the handle until the driving is completed. He then moves the scantling to the next post. This device entails but little extra trouble or expense, and by its adoption the posts and stakes remain much longer durable and in good condition.

Driving Long Stakes or Poles.—For driving hop or other long poles, which are usually set by making a hole with an iron bar and forcing into it the lower end of the pole, another device is recommended. This is to take "a block of tough wood, 1 foot in length, 4 or 5 inches square at the top, made tapering, with the part next the pole slightly hollowed out. Then wind a trace-chain closely about the block and pole, and hook it in position. With a sledge-hammer, or beetle, strike heavy blows upon the block. Each blow serves only to tighten the grip of the chain upon the pole. In this way quite large poles or stakes may be quickly driven

firmly in the ground. To keep the chain from falling to the ground when unfastened from the pole, it should pass through a hole bored through the block."

Post-hole Borer.—The earth-borer illustrated in Fig. 28 is a valuable labour-saving tool, and worthy the attention of all engaged in the erection of fencing. It is suitable for most kinds of soil, or for all purposes where a number of holes have to be bored in the shortest space of time.

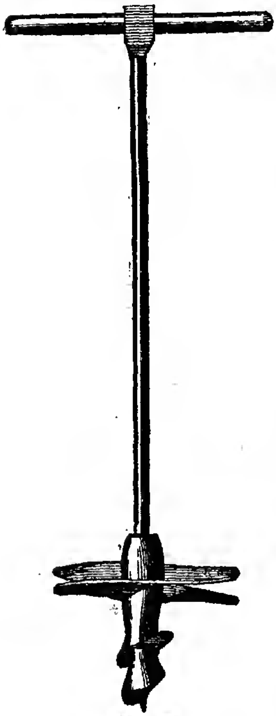


Fig. 28.

It lifts the soil from the hole without the necessity of using spades. After five or six revolutions 6 to 10 inches of earth will be gathered in the wings of the borer, which must be raised and shaken off. In stony ground it is necessary to move the borer to and fro after two or three revolutions. Small-sized stones go through the wings of the borer, but the larger ones must be removed by hand or in other manner. The German, Austrian, and Russian Governments have adopted the borers for placing palisades; and the Royal Prussian Telegraph Company use nothing but the Patent Borers for boring the holes for their posts.

The borers vary from 3 to 18 inches in diameter, and cost from 11*s.* 6*d.* to 45*s.* each. They may be obtained from Messrs. F. Morton and Co.

Post-hole Digger.—A post-hole digger much used in America for this purpose, as well as for planting trees, is illustrated in Figs. 29 and 30. The principle on which it works makes it self-cleaning, and prevents adhesion in sticky soil; therefore it always works freely and easily. It works well in stony, sandy, or clay soils; and quicksand under water is as easily removed by it as if no water existed.

Fig. 29.

Fig. 29 shows the digger with the blades open, ready to be plunged into the ground. Fig. 30 shows the instrument as it is drawn out after grasping the sand or dirt.

One man with this digger can do much more work, in a given time, than with a bar-and-post spade; and anything that can be loosened and reduced to 5 inches or less in diameter can be easily removed by it. As constructed for ordinary use it will dig readily 4 feet deep.

The mode of using the digger is as follows:—Plunge

it into the ground, as shown in Fig. 29, and when the soil is loosened, pull out the lever with one hand, as shown in Fig. 30, which will press the dirt between the blades; then draw the digger from the hole, keeping hold of the lever with one hand and the handle with the other. When the digger is clear of the hole, by simply pressing down the lever, which will open the blades, the dirt will fall from between them. The digger is then ready for another plunge. The steel blades are 9 inches long, and the whole tool 5 feet long. The price is 20*s.*; and the instrument may be obtained from Messrs. Bayliss, Jones, and Bayliss.

Fig. 30.

Post - and - Rail Fence.—In this kind of fence the posts are usually formed of cleft oak, 5 feet 6 inches in length, with four holes for rails, as shown in Fig. 31, and the bottom portion, which is fixed in the earth, is charred to prevent decay. The general sectional dimensions of the posts are 6½ inches by 3½ inches.

They are made more bulky at the lower end than the upper, and are fixed in the ground by digging holes, $2\frac{1}{2}$ feet deep, placing them therein, shovelling the soil in, and ramming it around the posts till they be firmly fixed.

Fig. 31.

The rails are generally from $3\frac{1}{2}$ to 4 inches broad, and about 2 inches thick. The distance between the posts is 9 or 10 feet.

Such a fence, having oak posts and rails, and four rails in height, will cost about 1*s.* per lineal yard.

Being very strong, these fences are suitable for enclosing cattle and horses. A good point in their construction is that each rail or bar is independent of the others, and can be taken out or replaced without much trouble, unless the rails are nailed or pegged to the posts, which is unusual.

It takes, however, a large amount of labour to mortice the post and fit the bars or rails, and the fence can only be erected with advantage in districts where timber is abundant and cheap.

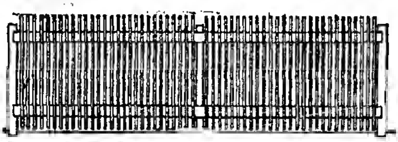


Fig. 32.

Upright Spar Fence.—As a garden fence, or for confining poultry, an upright spar-wood fence, like that illustrated in Fig. 32, will be found both effectual and cheap, where something more ornamental is wanted than for ordinary field purposes. It is made by fixing perpendicular posts in the earth, nailing two rails of

wood horizontally, one near the ground and another near the top of the posts, and covering these with spars nailed on upright, the spars not being above 2 or 3 inches broad.

Loose Rail Fences.—A primitive fence may be formed without nails or ties of any sort by inserting the stakes in the ground in different directions, and by using forked or hooked stakes. They are out of place in old settled countries, but may be found useful in pioneer farming. In America a still more simple fence is commonly met, even in districts that have been settled for a generation or more. It is known as the "Virginia crook," or worm-fence, and consists of nothing but cleft rails, similar to those employed in the cleft post-and-rail fence, and these are laid down in zigzag fashion, and one rail placed above another to the desired height, no posts or stakes and no nails being used. It forms a very strong fence, though a rough one, but it occupies a great deal of ground. It is, however, easily taken down and rebuilt again, while it will turn any and every description of stock.

CHAPTER XII.

WIRE FENCES.

THE construction of wire fences has of late years greatly extended, the portability and durability of the wire rendering its employment more convenient and profitable than the use of wooden rails or any other description of fencing.

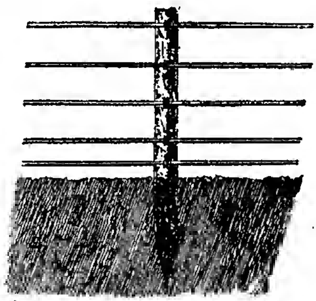


Fig. 33.

The wire fence most in use for farm purposes has all the straining and intermediate posts of wood, as in Fig. 33, and the wires are strained by a portable strainer. This system is far from satisfactory, because the wires are seldom

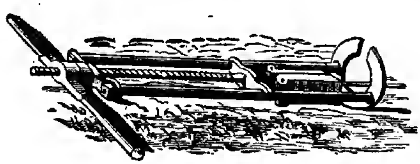


Fig. 34.

well strained, and when the posts begin to decay the whole fence gets loose and worthless. Fig. 34 shows

an improved form of portable strainer, used in the erection of such fences as the one here described. The wires are fastened to the posts, both terminal and intermediate, by means of galvanized wire staples. A fence of this kind, with wooden posts 6 feet apart, and having 5 single wires in height, costs about 8*d.* per lineal yard.

A much more substantial wire fence with wooden posts is illustrated in Fig. 35. In this case there are

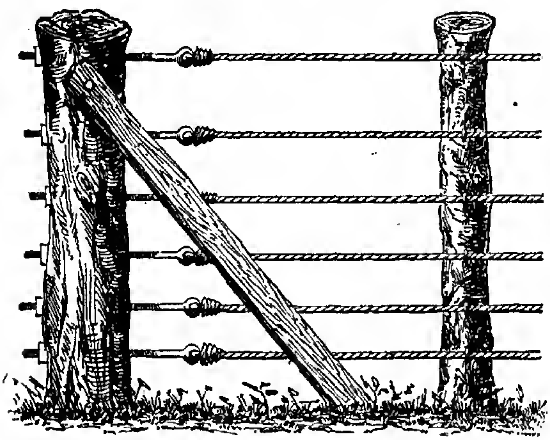


Fig. 35.

6 lines of wire, and each line consists of a 3-ply strand. Instead of the wires being fastened to the terminal by staples, holes are bored through the post in the lines of the wires, and straining eye-bolts with nuts and washers are attached for tightening up the fence. The same strand wires as the above are frequently erected on iron posts and pillars, for which the eye-bolts are equally adapted. Fences of this description are, however, too expensive for general farm purposes, and are

only erected as roadside fences, or in other situations where a fence of extraordinary strength is required.

A further improvement in the erection of wire fences has been reached by the introduction of the winding bracket, illustrated in Fig. 36. It is likely to entirely supersede the use of the screwed eye-bolts and of portable strainers, and is equally suited for applying to iron and wooden pillars or posts. The winders vary in price from 1*s.* 4*d.* to 3*s.* 6*d.* each.

Fig. 36.

Straining - pillars and posts fitted with these winding brackets are now extending in use. An iron straining-pillar of this kind is illustrated in Fig. 37.

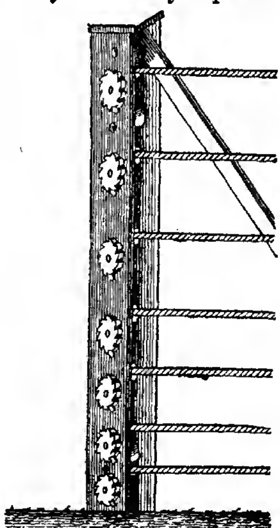


Fig. 37.

Corrimony Wire Fencing.—The Corrimony fence was originally intro-

duced to this country by the New Zealand colonists, and has now gained for itself a recognised position as the most economical fence for sheep. This is particularly the case in hilly districts, where the expenses of carriage and erecting tell heavily against ordinary fences.

The distinguishing feature of the Corrimony fence is that the fixed standards (of wood or iron) are placed at a considerable distance apart, varying from 12 to 22 yards, and that in the intervening space the wires are prevented from being pushed apart by being fixed to

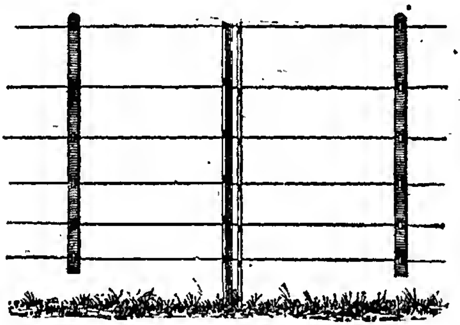


Fig. 38.

"droppers" placed at intervals of 6 feet. These droppers do not go into the ground, so that the fence possesses a certain degree of elasticity in a lateral direction between each pair of standards. The droppers can be either made of iron or of wood, but must be very light, so as not to overload the fence.

Fig. 38 shows a Corrimony fence, by Bayliss, Jones, and Bayliss. The standards are of angle-iron, and are punched on a patent principle which admits of the wires being fastened without threading. Fig. 39 is an enlarged view of this standard, showing the recesses for

the wire. There are 6 lines of steel wire, and a light iron dropper every two yards. The cost of this fence, exclusive of straining-pillars, is 7*d.* per yard, or £42 5*s.* per mile. A straining-pillar will cost about 32*s.* 6*d.*, and one is required for every 250 yards.

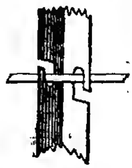


Fig. 39.

The wires are fastened to the iron droppers in the above fence by means of self-acting tongues or clips, and when the lines are erected they are placed in the tongues, which are closed with a hammer as soon as the fence is drawn taut. Fig. 40 is an enlarged view of dropper showing tongue fastening wire.

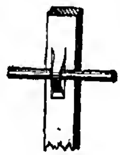
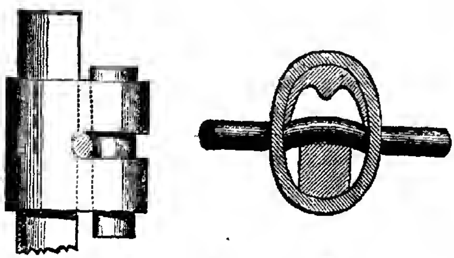


Fig. 40.

Fig. 41 shows full-sized section and side view of A. and J. Main and Co.'s "vice-grip" dropper, with wedges and clips complete, and the wire fixed.

When wooden droppers are used the wires are fast-



Side View. Fig. 41. Section.

ened by small staples, or passed through holes bored for the purpose, and secured with wooden wedges.

Barb Wire Fencing.—Steel barb fencing has of late years been extensively adopted in preference to plain wire fencing, in consequence of the deficiencies of the

latter in so many respects. The single wire snaps in cold and sags in heat, and the fence soon falls out of repair. The plain single wire is not sufficiently visible to animals, so that they often run against it by accident, and it does not repel the roving and venturesome. To meet these objections the principle of arming the wire with sharp barbs or spikes originated in 1873, since which time barb fencing has been the object of many improvements.

Barb wire fencing should consist of at least two barbs, used in connection with two wires twisted together for the sake of strength, and the better to resist all changes of temperature. The barbs used in connection with two wires should not be twisted around both of them, but

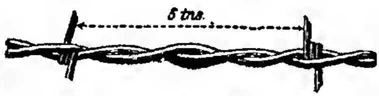


Fig. 42.

pass between them, in order to prevent their becoming loosened, and the barbs should not be more than 5 or 6 inches apart (Fig. 42). The barb must be short enough not necessarily to tear the animal. A sharp, instantaneous prick is all that is needed. Experience has shown that wire fences unprotected by barbs, no matter what the size of the wire, cannot withstand the pressure of a full-sized ox or horse, and the only effectual resistance is in the sharp prick of the barb used in connection with the wire. And further, a barb which is not sharp enough to prick and repel at the moment of contact invites further pressure by the animal rubbing its body against it, which results in destroying the fence.

Barbs two in a group are considered equally as effective as four in a group, for the reason that barbs

used two in a group, in combination with two wires, are caused by the twisting of the wires to project in every direction, so that it is impossible for any animal presenting one foot of surface to press against a wire thus armed without being effectually met by a point.

The number of barb lines or wires to be used must be decided in each case by the special object of the fence. One line 4 feet from the ground will turn cows, oxen, and horses. Two lines 21 inches from the ground and from each other will turn smaller cattle as well as the larger ones. Three lines, the lowest 12 inches from the ground, the next 24 inches, and the third 42 inches from the ground, will accomplish all named above, and make a thoroughly good and substantial farm fence. Four, five, and even six lines are frequently used when some special object is in view, such as excluding dogs, pigs, and other small animals, in which cases the lower lines are placed nearer to the ground and to each other than are the upper lines.

With cattle the great advantage of barbed wire is that it keeps them in; with sheep, it keeps their enemies out (Fig. 43). This is a very substantial fence, erected by Felten and Guilleaume. In some districts the havoc made amongst sheep by prowling dogs is immense, but steel barb fencing, properly erected, is dog-proof.

Many combinations can be formed with barb fencing and other styles of fence. One line or wire on the top of any wooden fence makes a structure cattle will not molest. One or two barb wires put up with the old plain wire, or entwined in the line of a hedge, makes a magical change in the efficiency of the whole.

In large quantities barb wire, double strand, and with the barbs 5 inches apart, costs less than one penny per yard.

We have seen a fence of this kind in America, but with three lines of wire instead of four, and with the posts 50 feet apart, which was apparently effective

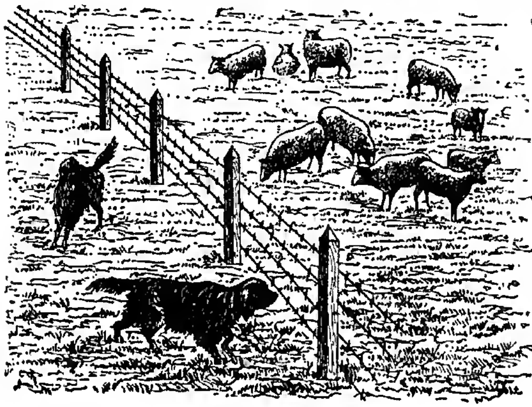


Fig. 43.

against cattle, and cost on a large contract only £25 per mile, or about $3\frac{1}{4}d.$ per yard.

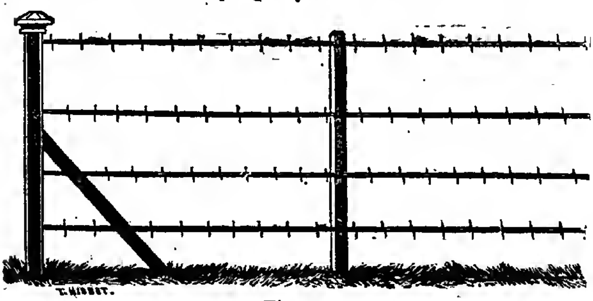


Fig. 44.

Fig. 44 shows a barb wire fence with iron standards, as erected by A. and J. Main and Co. The terminal is a winding-pillar, and tongues are cut at the backs of

the wire standards, along which the wires are passed, and after being strained the tongues are clasped down by the stroke of a hammer, thereby securing the wires effectually in their places. The fence is usually made with four lines of galvanized steel barb wire, the standards 10 to 20 feet apart. The cost of such a fence varies from £64 to £50 a mile.

Iron Bar Fencing.—Fences of this description are too expensive for ordinary farm purposes. For surrounding parks and pleasure grounds, however, and as road-side fences, they are much in demand, as they present a good appearance combined with great strength

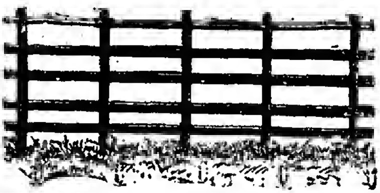


Fig. 45.

of resistance to the pressure of the large animals which is frequently brought against them in such situations.

Iron bar fencing is of various kinds, as flat or round, solid or tubular bars. The usual mode of constructing bar fencing has been upon the principle of having the horizontal bars all jointed at one standard—an arrangement opposed to sound mechanical principles, and which is now improved upon by Messrs. A. and J. Main and Co. In this new "break-joint" construction, the top bar is jointed at a different standard from the lower bars, as seen in Fig. 45, thus distributing or breaking the pinnings, and securing to the fence its full lateral stiffness.

Unclimbable Strained Wire Deer-Fence.—Fig. 46 shows an elegant and effective fence for surrounding or subdividing deer-parks. Many miles of this description of fence have been used in surrounding the Royal parks at Windsor. It is 6 feet high above the ground, with standards $1\frac{1}{2}$ inches by $\frac{3}{8}$ths of an inch, 9 feet apart, having anchor-formed and double-pronged feet alternately, 18 inches below ground. The straining-

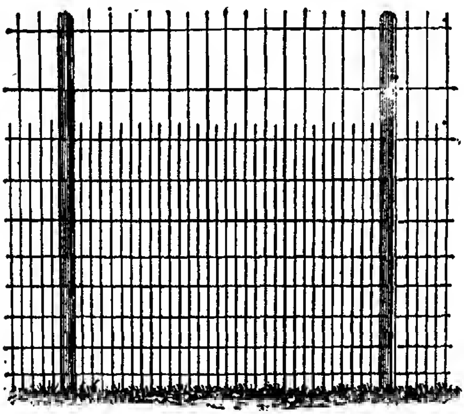


Fig. 46.

pillars are of cast-iron, prepared to fix on stone, each fitted with a double stay, and placed 100 yards apart. The horizontal wires are ten in number, and upon these are placed vertical wires alternating in length, as shown in the engraving, and placed $1\frac{1}{4}$ inches apart in the lower part of the fence, thus rendering it perfectly game-proof and unclimbable. These wires are laced upon the horizontal wires, and are pointed at the top. A fence of this kind can be erected at a cost of about 8*s.* 6*d.* per lineal yard.

Wire Netting.—Galvanised wire netting is now largely used for enclosing paddocks and turnip fields, &c., or for fencing rabbit-warrens, poultry-yards, pheasantries, &c. Three-inch mesh netting, 3 feet wide or high, costs $4\frac{1}{2}$*d.* per yard; 4 feet wide, 6*d.* per yard.

Fig. 47 represents the mode of erecting wire netting, devised by Lord Elcho, the present Earl of Wemyss, for preventing rabbits burrowing under it. A is a separate strip of galvanized wire netting, 6 inches wide, and 2-inch mesh, which is laid flat on the ground on the side of the fence from which rabbits come, and

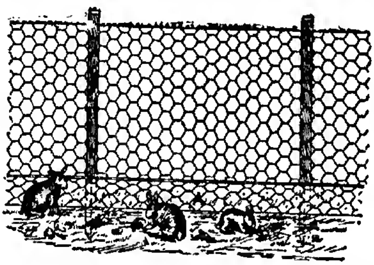


Fig. 47.

attached here and there to the upright netting. The grass, fallen leaves, &c., soon conceal the netting thus laid down, and the rabbit vainly scratches upon it, his intelligence failing to teach him to begin his tunnel farther back. The strips cost about 6*s.* 6*d.* per 100 yards, including a proportionate quantity of soft tying-wire.

The old modes of fixing wire netting around rabbit burrows, &c., are to dig a trench 6 inches deep and more, and drop the netting into it, or to fill the trench with broken stones or concrete; but these methods are both troublesome and expensive.

When extra strong netting is required, it is secured with one or more centre 3-ply strands. As a kangaroo fence in Australia, where galvanized wire netting is now extensively used for this purpose, the meshes are 6 inches wide, and at least two centre 3-ply strands are added for additional strength.

For poultry fencing, galvanized wire netting on strong iron frames, standing 6 or 7 feet high, is commonly used. Such a fence costs 3*s*. to 4*s*. per lineal yard, and answers well for enclosing the poultry yard, but in other quarters a cheaper fence against poultry will be equally efficient.

Where pheasants are reared, the fence is usually made about 7½ feet high, and the lower half is covered with galvanized corrugated sheets, to prevent foxes disturbing the birds, and the upper half with galvanized wire netting.

CHAPTER XIII.

MOVABLE FENCES.

UNDER this head are comprised all the different kinds of hurdles, and also sheep nets, which are in use for shifting folds in feeding off root and green crops or grass, and which are likewise extremely useful and convenient at times for temporarily dividing a field—as when one part of a field is left in pasture for grazing and the other part is brought under crop culture.

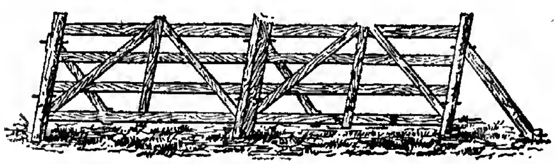


Fig. 48.

Hurdles may be divided into various classes, as wooden and iron, open and close, sheep and cattle hurdles, &c.; but it will be sufficient to notice briefly a few of the varieties most in use.

Scotch Hurdle or Flake.—This hurdle, as seen in Fig. 48, consists of two posts, each 2 × 3 inches and 4½ feet long, having the lower ends long and pointed for entering the ground, four rails, one brace, and two diagonals. They are made of larch or fir-wood, the usual

dimensions of the hurdle being 9 feet long and 4 feet high. The cost is about 2*s*. each. The mode of setting them is to let the hurdle incline away from the sheep, a rance or stay being placed between every two hurdles to keep them in position, with a wooden peg or pin fastening one end of the rance to the hurdle, and another peg driven through the other end of the rance into the ground.

The flake is, withal, a clumsy and weighty hurdle. To move a number of them any distance in a field they must be put on carts, and a single-horse cart can only carry a dozen of them conveniently, while they are easily broken in the process of unloading. When set in position, too, they are very liable to be blown over by high winds, from the amount of surface exposed by their flat bars.

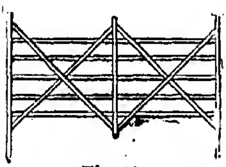


Fig. 49.

English or Welsh Hurdle.—The English wooden hurdle is a lighter, cheaper, and more convenient article than the Scotch flake. It is generally made of split oak, and is very tough and almost unbreakable. It consists of two upright end pieces, joined by four or five mortised bars 7 to 9 feet long, which are strengthened by an upright bar in the middle and two or more diagonals. The end pieces are long, and pointed for setting into the ground, which is done with an iron crowbar to avoid driving and splitting the top.

Sometimes they are made with the two sides to answer either as top or bottom, Fig. 49, by which means, if a leg is broken off, it is only necessary to turn the hurdle upside down to have still a perfect hurdle.

These hurdles are set erect, and no rance or stay is used, the ends of the two adjoining hurdles being simply connected by means of a withe band passed over them.

In exposed situations it is sometimes the practice to wattle either furze or straw between the bars of such hurdles as are set to windward.

Wattle Hurdles.—Wattle or close hurdles, made of hazel rods, afford a good shelter to sheep, and are very light to handle, and tolerably durable. They are made about 7½ feet long and 3 feet high, consisting of ten vertical stakes, the two end ones of which are stronger, and project both above and below the hurdle. The lower end is pointed for entering the ground a short way, and the upper end is for receiving the shackle which fastens the ends of two adjoining hurdles to the stake which is driven into the ground between them. The hurdles are closely wattled with rods. The price of these wattle hurdles is 10*s.* or 12*s.* a dozen in the copse districts, out of which they can seldom be obtained.

The stakes used with the wattles are cut 6 to 7 feet long, and sell at about 4*s.* per hundred. They are pointed, and let into the ground by an iron crowbar or stake-pitcher between two of the hurdles, and a shackle of twisted rods is put over it and the projecting heads of the adjoining hurdles to hold the whole together.

Rack Hurdles.—Hurdles of this class are used in feeding off vetches, clover, and other crops which it is not desirable that the sheep should run over while feeding upon. They are placed against the crop, and the sheep eat through the bars, the hurdles being shifted forward once or so every twenty-four hours. When fresh food is required the hurdles are drawn forward a yard or so, and are not fixed in the ground, but are placed in a leaning position, resting on stays, as shown in Fig. 50. The hurdles are connected by means of a shackle. The crop is fed off in the direction in which

it is wished to plough the land, so that the plough may follow close upon the sheep.

Lamb-Creep.—The lamb-creep or hurdle is used in folding ewes and lambs on turnips, clover, grass, &c., in order that the latter may take their range at will of a field ahead of the ewes, and enjoy a nibble among the fresh grass or turnip-tops, &c., which contributes greatly to the health and future growth of the young animals; it also enables the lambs to be supplied with some box feeding out of the reach of the ewes.

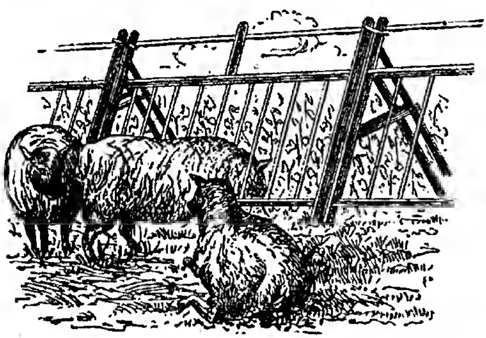


Fig. 50.

The lamb hurdle is made of the usual length and height, and is very similar to the rack hurdle, but it is divided into two portions by a horizontal bar midway between the ground and the top rail, and the lower half is subdivided by rolling upright bars 10 inches apart, just wide enough to allow the lambs to get through. The upper half has one or more uprights to give the whole the requisite strength.

Revolving Hurdles.—Fig. 51 is a representation of Brown's patent Chevaux-de-Frise Hurdle, combined with his rain-shower irrigation system for pasture land

grazing, showing a distance of 300 yards of these hurdles, with 200 sheep grazing through the spikes. It also shows the mode of turning them on to fresh grass, with the back hurdle following, removing the sheep from the land after the grass has been grazed. The land is watered by the rain-shower irrigation, the water being pumped from a tank in the field, fed by a small spring stream which passes through the land at Stoke Park, near Windsor, where this system has been laid down.

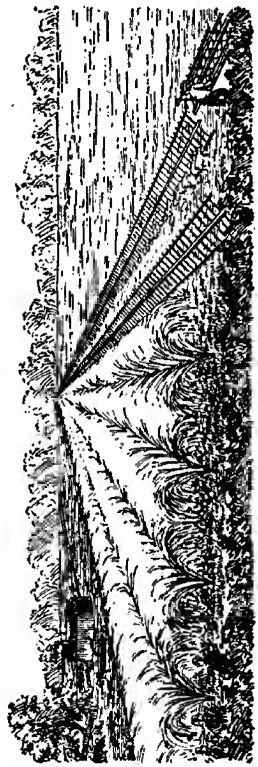


Fig. 51.

These hurdles are manufactured by machinery from American pitch-pine for their spikes, and Baltic timber for beams and bars, and are estimated to last fifteen to twenty years. The price is 3*s*. per yard.

This system of grazing was brought into use in July, 1881, upon the farm of Bonaly, at Colinton, near Edinburgh, upon land properly laid down for the growth of grass without the irrigation system. Sheep at the rate of forty to the acre were grazed and fattened, from the 28th of July to the 26th of September of the same

year, increasing in weight over 3½ lbs. per week for each sheep, as ascertained by Mr. John Penman, Bonaly, by weighing the sheep when put upon the grass and taken off, and as reported in the Edinburgh papers—*Scotsman* and *Courant*—of the 13th and 15th of October, 1881. This result shows that not less than fifty sheep may be taken as the number that may be fattened to the acre from April to October upon land properly laid down in grass for the system; and these gaining only 3 lbs. each in live weight, 1,200 lbs. may be estimated as the produce upon an acre, which, at the low price of 4½*d.* per pound, would give a value for the grass and feeding stuffs consumed of £22 10*s.*, showing a balance of profit to the credit of this system, after deducting cost for management of land, feeding-stuffs, attendance, and interest on capital invested in sheep, of over £6 an acre.

This hurdle has also been introduced as suitable for feeding off turnips, as it gives facilities for eating up one drill, and preventing further access by the sheep to the crop till each drill is wholly consumed, and also for one shepherd attending to a very large number of sheep —500 or more. One hundred yards of hurdles are sufficient for 100 to 150 sheep. The back hurdle is not required for turnips, nor for eating off foggage or ordinary pasture grass, upon which a very large saving will be effected. In wet seasons its use may be fairly estimated to double the value of a turnip crop when eaten off by sheep, or even during the most favourable weather the larger waste which always takes place from plot hurdling will be prevented.

Fig. 52 represents an easily made and portable revolving hurdle. "It consists of a pole or scantling 10 feet long, bored with holes alternately in opposite

directions, and 12 inches apart. Stakes 5 feet long are put through these holes, making a hurdle with a cross-section like the letter X. These hurdles are merely

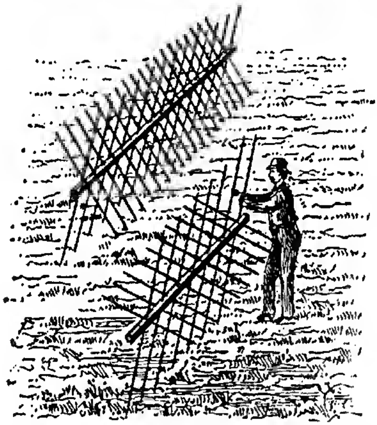


Fig. 52.

placed upon the ground, resting upon the ends of the stakes, and may be rolled over and over from place to place."

Hurdle on Wheels.—For sheep-folding, a strong iron hurdle (Fig. 53), 12 feet long and 3 feet 6 inches high, and fixed upon four wheels, made by Hill and Smith, is often used. Hurdles of this kind are rather expensive,

Fig. 53.

owing to the wheels. The advantage of using them is the readiness with which they can be shifted, as no driving of stakes is necessary.

Iron Stand Hurdles.—Messrs. Dougherty and Bradley,

East Dereham, had on view at Reading, in 1882, a wrought-iron hurdle, with feet or stands of grooved iron to receive it. "*A* (Fig. 54) is the hurdle in position; *B* the sectional end of the upright, showing a groove for slipping in the hurdle *D*; *D* is the plain hurdle lifted out of position for moving; *C* is a small wooden foot for the upright. The hurdle is slipped into a groove riveted to the side of the upright *B*, and can be quickly removed by one man." The price of this hurdle, 3 feet or

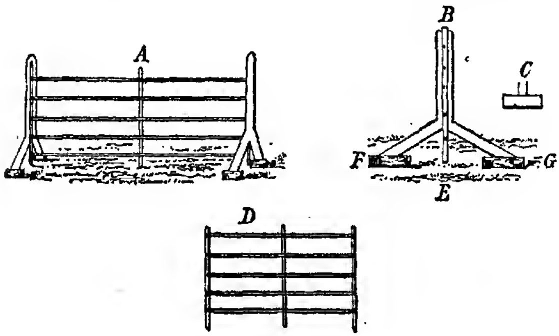


Fig. 54.

3½ feet high, including stands, is 2*s.* or 3*s.* per lineal yard, with 2*s.* extra for each single stand.

Iron Hurdles.—There are now a great variety of iron hurdles in use, but the lightest of them are too heavy for ordinary sheep-folding when the hurdles have to be moved daily. As a temporary fence, however, in dividing a field or meadow—for instance, where one-half is to be mown and the other half fed—they are superior to wooden hurdles. For sheep-folding purposes they are best with plain pointed feet and one middle upright. They are made to various sizes, suitable either for sheep or for cattle.

The hurdle by J. J. Thomas and Co., represented in Fig. 55, is made with one middle upright, and the terminal uprights have fringed feet for fixing in the ground. Hurdles of this class are well adapted for a roadside fence, and are now commonly made without riveting, the horizontal bars being simply threaded through the end upright and clinched by a double thread.

Net Hurdles.—These are made of network of small cord, the size of the meshes 3 or 4 inches. The width or height of the net is about 3½ feet. They are usually made in lengths of 50 yards, and are supported by stakes 8 or 10 feet asunder. "Each net is furnished with a rope along both sides, passing through the outer meshes,

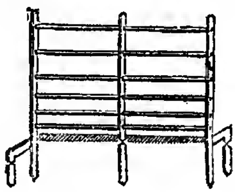


Fig. 55.

which are called the 'top' and 'bottom rope,' as the position of either may be at the time."

The nets are fixed to the stakes on the side facing the ground the sheep are to occupy, and may be set up either towards the right or the left, as the starting-point happens to be situate. Having fastened the loose ends of the top and bottom ropes to the first stake, on coming to the second "the bottom rope gets a turn round the stake, and is fastened with the shepherd's knot 3 inches from the ground. The top rope is then fastened with a similar knot near the top of the stake, stretching the net even and upwards; and in this way the net is fastened to one stake after another, care being taken to

make the top of the net run uniformly throughout its entire length." When more than one length of net

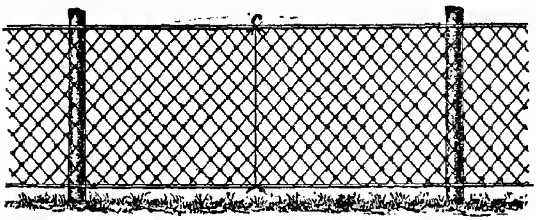


Fig. 56.

is required, the ends of two nets are joined, as at *c*, Fig. 56.

"The shepherd's knot is made in this way. Let *a*, Fig. 57, be the continuation of the rope which is fastened to the first stake, then press the second stake with the hand towards *a*, or the fastened end, and at the same time tighten the turn round the stake with the other hand by taking a hold of the loose end of the rope *d*, and moving it so as to cause it to pass under *a* at *c*, and screwing it round the stake to *b*, where the elastic force of the stake will secure it tight under *a* at *b* when the stake is let go. The bottom rope is fastened first, to keep the net at the proper distance from the ground, and then the top rope, care being taken to pass the top and bottom ropes round the stakes, so as the leading coil of the rope is always uppermost towards the direction in which the net is to be set up. Thus in Fig. 57 the rope *d* was uppermost until it was passed under *a*, because the setting of the net in this case is from right to left, and it continues

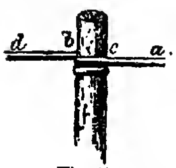


Fig. 57.

to be uppermost until it reaches the next stake to the left."

These cord nets, in 40-yard lengths, and 3 to 3½ feet wide, cost, in Scotland, about 12*s.* 6*d.* each, or 3*d.* per yard. Tarred sheep-netting, of the same material, in 50-yard lengths and 4 feet wide, costs in London £1 13*s.*, or nearly 8*d.* per lineal yard. Cocoa-fibre netting, tarred, in 100-yard lengths, 4 feet wide, costs in London £1 15*s.*, or nearly 4½*d.* per lineal yard. These prices do not include stakes for fixing the nets.

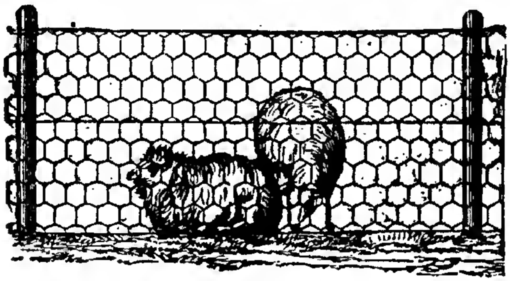


Fig. 58.

Wire Sheep-Netting.—Galvanized wire netting being more durable than the cord nets, is coming largely into use among flockmasters in lowland districts. It is made by A. and J. Main and Co. in 25-yard rolls, and with a 4-inch mesh, and standing 3 feet high (Fig. 58), costs about 5½*d.* per yard. Stakes for fixing the netting are extra.

* Stephen's "Book of the Farm."

CHAPTER XIV.

FIELD GATES.

GATES of one kind or another are necessary to afford communication between field and field, and also for opening on roadways. Their position cannot always be decided on without considering the roads and other communications with which they are connected, as well as the size and shape of the field; but it is mostly in the line of the headland at a corner of the enclosure, and in steep ground more commonly at the lower than at the upper part of the field.

No field gate should be less than 10 feet wide, to permit the free passage of loads of hay and straw, and of traction-engines, field-rollers, and other implements and machines.

Wood and iron are the materials of which gates are constructed, and farm gates in particular are most commonly of the former.

All farm gates should be supplied by the landlord, who should always have a stock of ready-made gates on hand, and give out a new one whenever a tenant sends in the remains of an old worn-out gate.

Wooden Swing Gates.—A good form of wooden gate, by Blenkarn, is shown in Fig. 59, with the iron-work and other portions drawn to a larger scale.

Hanging a gate on wooden posts is a matter of some

difficulty and importance. The posts should be heavy, 8 inches square, planted 4 feet deep in the earth, firmly rammed around, and as little higher than the gate as possible. The gate should be hung so that it can only swing one way, and it should open inwards to the field, and not to the road.

To set the posts so that they will remain upright and prevent the sagging so common in field gates, dig the holes the usual depth, but open the whole length of

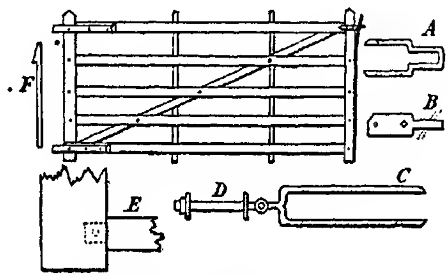


Fig. 59.

A Clasp for spring-fasteners.
B Side view.
C Hinge strap.
D Hook and bolt through post.
E Shows rail-tenon and method of pinning into heel of gate.
F Hook or gate-fastener.

ground between post and post. Place the posts in position, and then lay a stout slab or plank in the bottom of the open trench, with an end pressing firmly against each post. Over this plank fill in the soil to within a foot or so of the surface, beating and ramming it firmly all the while. Then lay another slab, fitting closely to both posts as before, and fill in the remaining soil above it. In soils liable to slip or heave, a stay should also be put in at the back of each post, 2 feet or so below the ground surface. Gates so hung will never sag.

Folding Gates, made in two parts, are sometimes used for wide spaces, where one gate occupying the whole would be too large and heavy. The great objection to them is that, without a centre-post, which is always inconvenient in a gateway, they cannot be steadied, and soon sag, from the constant wobbling or from people climbing upon them.

Wrought-Iron Gate and Posts.—Fig. 60 represents a wrought-iron field gate, manufactured by Messrs. Hill and Smith, which has obtained the silver medals of the Royal Agricultural Society of England, and of

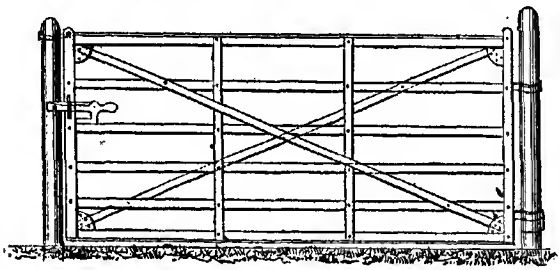


Fig. 60.

the Royal Agricultural Society of Ireland. It is constructed principally of angle and T-iron, which impart great strength and rigidity to the gate without a corresponding increase in weight, and it is hung to the post by thimbles, as shown in the engraving, which slip over the top of the post. The posts are of solid wrought-iron, with basements of plate iron so disposed as to have great holding power in the soil, and quite sufficient, when well rammed in stiff soil, to carry the gate without either stone or wood-blocks.

The price of this gate, with posts and hangings complete, is £3 7*s.* 6*d.*; without posts, £1 7*s.* 6*d.*

Wrought-Iron Unclimbable Gate.—This gate (Fig. 61) is intended for situations exposed to trespassers. It is constructed of flat iron uprights pointed at top, riveted to angle-iron frame-work, and placed 2½ inches apart in

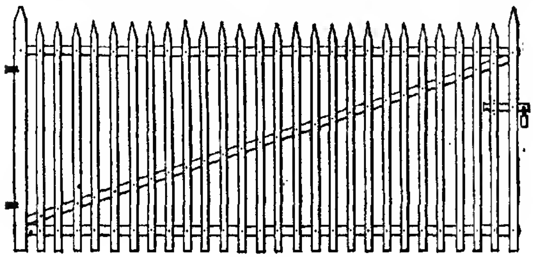


Fig. 61.

the clear. A capital gate of the same pattern is made out of wooden spars.

Wire Gates.—Although plain wire is an unsuitable material for the construction of field gates, being too light to bear the pressure of animals against it, this

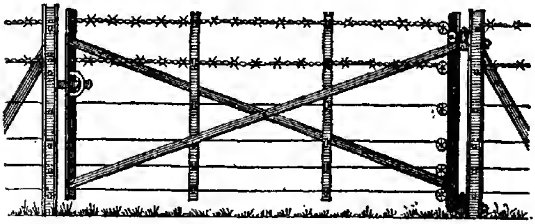


Fig. 62.

objection is entirely removed when barb wire is employed in the gate, if only for the top bars, as no animals will then push against it. Fig. 62 shows a useful gate of this kind, in the line of a barb wire fence

The gate is hung upon ordinary iron straining-posts, and the heel of the gate, which is of angle-iron, is fitted with winding-brackets for tightening the wire bars.

A much cheaper and simpler form of wire gate is

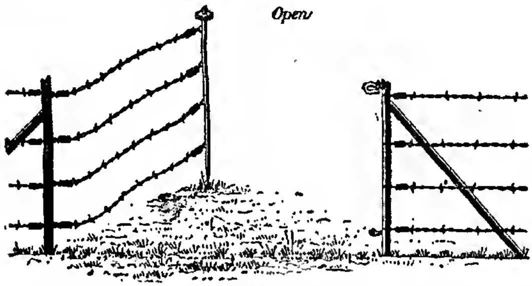


Fig. 63.

shown in figs. 63 and 64, in the former of which the gate is open and in the latter it is shut.

A Sliding Gate.—Gates of this class (Fig. 65) are sometimes used in the line of a paling or wire fence.

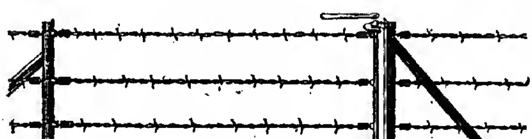


Fig. 64.

They have nothing to recommend them, however, but cheapness, there being no posts and hinges required, as in the hanging gate. The left half of the gate slides backwards between two common fence-posts, which are attached by as many horizontal spars as there are bars.

in the gate, and the other end of the gate slides two or more of its bars into iron holdfasts, or the ends of all the bars may slip between the horizontal spars

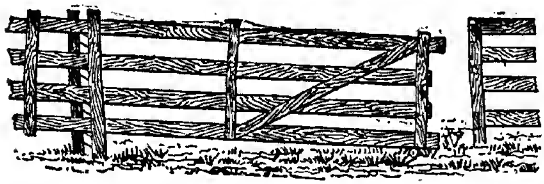


Fig. 65.

attaching two fence-posts, as at the left of the gate. These gates are not so readily opened and shut as a good swing-gate, and this is a great objection when there is much traffic at the gateway.

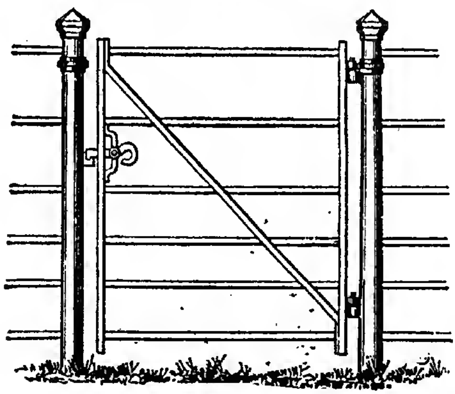


Fig. 66.

Hand or Bridle Gates.—For bridle-roads and pathways small hand-gates of wood or wrought-iron are a great economy in place of the large field gates, and much more convenient. The wicket is equally adapted

as a side gate to field gate, or for standing alone, the posts forming terminals in a line of fence, as in Fig. 66. A wrought-iron wicket of this kind costs from 15*s.* to 17*s.* 6*d.* without the pillars.

In the American wooden hand-gate, which is illustrated in Fig. 67, no blacksmith work is necessary. The hinge-post is 9 or 10 inches and the latch-post

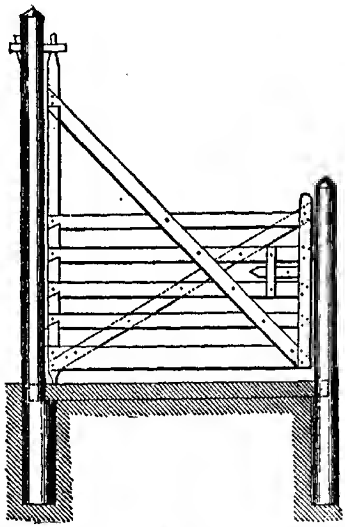


Fig. 67.

8 inches in diameter, both being sunk 3 or 4 feet in the ground. A strong wooden sill is inserted at the ground-level, tenoned into posts and primed. This sill serves to strengthen the posts and to keep them in position. The bars and braces are dovetailed into the uprights. The piece at top, acting as a hinge, should be 3 inches thick, with a hole in it for the end of the heel to pass through. A hole is made in the sill for the bottom of

the heel to work in. The long hinge-post would be objectionable in a line of paling or wire fencing, but it is easily shortened, and the mode of hanging this gate is extremely simple and effective.

In hunting districts a few of these bridle-gates, judiciously disposed in the lines of fencing, and out of the lines of pathways and bridle-roads, will often prevent much injury and damage to the fences. In situations where no pathway leads to them the gates should invariably be painted a different colour from the fence, a

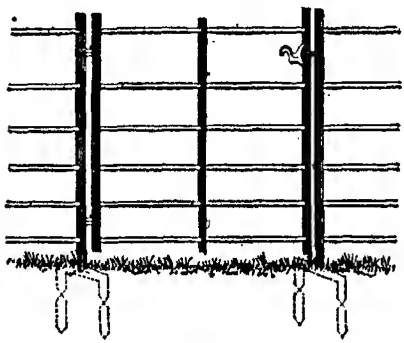


Fig. 68.

gate painted white being the most distinguishable at a distance.

Gate for Hurdle Fences.—These wickets are adapted to meet the demand for a cheap and simple hand-gate to hang between hurdles. They can be hung either to the sides of the hurdles or to standards specially provided for that purpose. A wrought-iron wicket similar to that shown in Fig. 68, and to match hurdles up to 4 feet high, costs 14*s.* or 15*s.*

When a footpath passes through a folded field, and no such gate as the above is available, an easy passage

is formed by placing three hurdles in the form of a cage-gate or bow-wicket, Fig. 69; that is, a movable one *c* swings on the stake *b* between the fork of two others

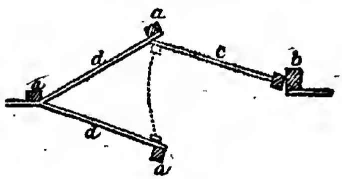


Fig. 69.

set to the stakes *a a*, so as to form an acute angle. This prevents passengers breaking or displacing hurdles by climbing over them or leaving them open.

CHAPTER XV.

WICKETS AND STILES

Many farms are intersected by public footpaths, which are often a great annoyance to the farmer on account of the fences being broken down or gates left open, and the livestock allowed to trespass amongst the growing crops.

Wickets and stiles are contrivances for such situations in order to allow men to pass over or through fences, while the passage excludes sheep, horses, or cattle. The wicket or turn-about is simply a zigzag or bow passage in the fence, and for temporary use may be formed of stakes and hurdles or posts and rails; but for a permanent passage, such as a public footpath, a well-constructed wrought-iron wicket will be cheapest in the end. There are many kinds of stiles adapted to different kinds of fences. In a dyke or stone wall three or four long stones placed in the height of the fence, and projecting at both sides of the dyke, serve the purpose of steps, by which the passenger ascends to the top and descends again on the other side. Sometimes a strong wooden ladder is fixed at either side of the wall. In a post-and-rail or wire fence, properly constructed fence-steps should be provided, either of the platform or step-ladder kind.

Bow Wickets.—The design of the bow wicket is to provide a gate that will be always shut and yet always

open. For footpath gates these are superior to every other kind, as they are not apt to get out of repair from

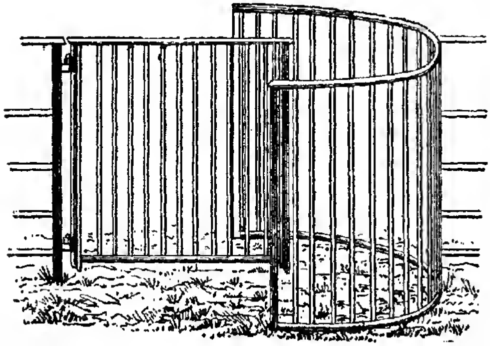


Fig. 70.

constant opening and shutting, having no latch, and are quite secure against livestock. Where there is much

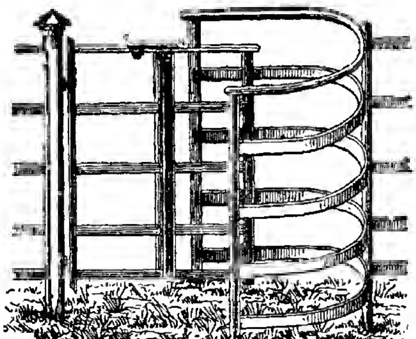


Fig. 71.

traffic they save the farmer from a great deal of annoyance, and even damage, by its being impossible to leave

them open. They may be fixed alongside large gates, or in lines of continuous fencing, and look well wherever placed.

A wrought-iron bow wicket is represented in Fig. 70, made with the bars vertical, and placed in the line of an iron fence. The person who wishes to pass this wickct steps into the bow, swings the gate to the front, and passes through to the rear, without the trouble of latching or unlatching, and no quadruped can follow.

Fig. 71 has the bars horizontal, and is hung on a cast-iron pillar. This wickct is also made to fold and

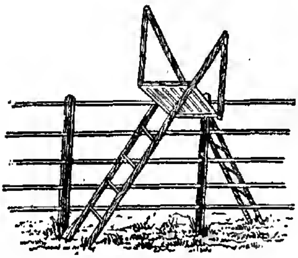


Fig. 72.

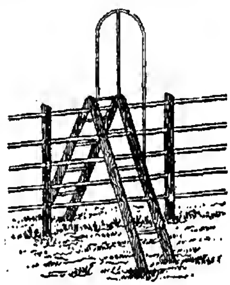


Fig. 73.

open when required, to allow a wheelbarrow or animals to pass through. The prices vary from 35*s*. to 40*s*. and upwards.

In temporary or movable fences, the cage-gate or bow-wicket described at page 114 may be adopted.

Fence-Steps or Stiles.—Step-ladders or stiles, similar to those represented in Figs. 72 and 73, are very generally used in connection with iron or wire fencing. They allow persons to get over the fence easily without injuring the bars or wires. The prices vary from 15*s*. to 30*s*. for wrought-iron steps, according to height and construction.

In a dyke or wall fence, stone steps built into the wall on both sides are most convenient. In a hedge fence, however, the bow-wicket, or an opening stile, will be more suitable.

Opening Stiles.—Several ingenious contrivances are in use for avoiding the climbing necessary in the old-fashioned stiles. Fig. 74 represents an opening stile, of

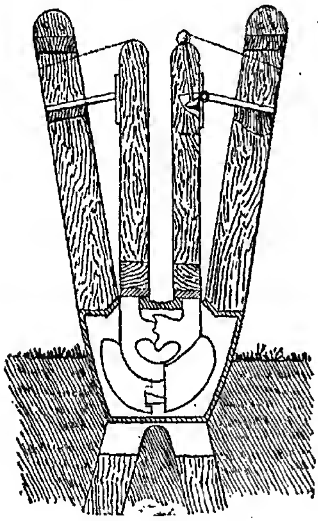


Fig. 74.

which there are several in the grounds at the Royal Agricultural College. It is the patented invention of Messrs Hill and Smith.

Fig. 75 shows another opening stile between two terminal posts in a line of iron bar fencing. This stile is by Messrs. F. Morton and Co.

The stile is made to open as follows. By raising the

small knob *b*, the two central posts are readily pressed aside, as shown by the dotted lines, allowing a free open space for passing through. On releasing the pressure these posts fall to again by their own weight, and are self-locking, thus rendering the stile secure against stock.

The stile is constructed for fixing either independent of a line of fence, or for intersecting a line of fence, in which position the two outside posts take the place of

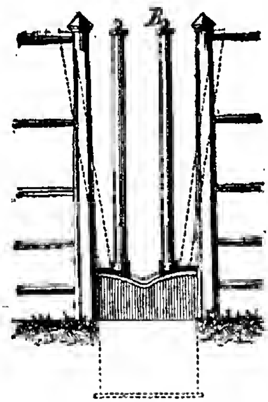


Fig. 76.

terminal posts for attaching the lines of wire, whereby a substantial saving in cost is effected in comparison with the expense of separate gate or terminal posts which would otherwise be required to admit of a gate being inserted or other opening made in the line of fence.

The stile is also arranged when required for fixing at one of the extreme ends of a line of fence, the wires being attached to one of the outside posts, which is fitted with an additional stay.

There are many other kinds of wickets and stiles to

be met with, but the foregoing include all those now commonly erected, and none of the others call for any special notice or description.

The lever-bar stile is an example of the latter class. It is, however, a very clumsy contrivance, and is well superseded.

Any kind of gate, wicket, or stile is, at the same time, preferable to a broken-down fence, or a gap-passage, which too frequently appears, even in the best of fences, at points where the necessary gate or stile has not been provided. And the sight of such gaps stopped by hurdles, or here and there, perchance, with an old harrow, is not calculated to encourage the idea of careful and tidy farming.

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